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AN
HISTORY
OF THE
EARTH,
AND
ANIMATED NATURE.

By OLIVER GOLDSMITH.

IN FOUR VOLUMES.

VOL. IV.

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H I S T O R Y

O F

TESTACEOUS FISHES.

C H A P. I.

Of the Shell of Testaceous Fishes.

ONE is apt to combine very dissimilar objects in the same groupe, when hurried into the vortex of method. No two animals are more unlike each other than the whale and the limpet, the tortoise and the oyster. Yet, as these animals must find some place in the picture of animated nature, it is best to let them rest in the station where the generality of mankind have assigned them; and as they have been willing to give them all, from their abode, the name of fishes, it is wisest in us to conform.

But, before I enter into any history of shell-fish, it may not be improper to observe, that naturalists, who have treated on this part of history, have entirely attended to outward forms; and, as in many other instances, forsaking the description of the animal itself, have exhausted all their industry in describing the habitation. In consequence of this radical error, we have volumes written upon the subject of shells, and very little said on the history of shell-fish. The life of these indus-

AN HISTORY OF

trious creatures, that, for the most part, creep along the bottom, or immoveably wait till driven as the waves happen to direct, is almost entirely unknown. The wreathing of their shells, or the spots with which they are tintured, have been described with a most disgusting prolixity; but their appetites and their combats, their escapes and humble arts of subsistence, have been utterly neglected.

As I have only undertaken to write the history of animated nature, the variety of shells, and their peculiar spots or blemishes, do not come within my design. However, the manner in which shells are formed, is a part of natural history connected with my plan, as it pre-supposes vital force or industry in the animal that forms them.

The shell may be considered as an habitation supplied by nature. It is a hard stony substance, made up somewhat in the manner of a wall. Part of the stony substance, the animal derives from outward objects, and the fluids of the animal itself furnish the cement. These united, make that firm covering, which shell-fish generally reside in till they die.

But, in order to give a more exact idea of the manner in which sea-shells are formed, we must have recourse to an animal that lives upon land, with the formation of whose shell we are best acquainted. This is the garden-snail, that carries its box upon its back, whose history Swammerdam has taken such endless pains to describe. As the manner of formation of this animal's shell extends to that of all others that have shells, whether they live upon land or in water, it will be proper to give it a place, before we enter upon the history of testaceous fishes,

To begin with the animal in its earliest state, and trace the progress of its shell from the time it first appears—The instant the young snail leaves the egg, it carries its shell or its box on its back. It does not leave the egg till it is arrived at a certain growth, when its little habitation is sufficiently hardened. This beginning of the shell is not much bigger than a pin's head, but grows in a very rapid manner, having at first but two circumvolutions, for the rest are added as the

snail grows larger. In proportion as the animal increases in size, the circumvolutions of the shell increase also, until the number of those volutes come to be five, which is never exceeded.

The part where the animal enlarges its shell is at the mouth, to which it adds in proportion as it finds itself stinted in its habitation below. Being about to enlarge its shell, it is seen with its little teeth biting and clearing away the scaly skin that grows at the edges. It is sometimes seen to eat those bits it thus takes off; at other times, it only cleans away the margin when covered with films, and then adds another rim to its shell.

For the purposes of making the shell, which is natural to the animal, and without which it could not live three days, its whole body is furnished with glands, from the orifices of which flows out a kind of slimy fluid, like small spiders' threads, which join together in one common crust or surface, and in time condense and acquire a stony hardness. It is this slimy humour that grows into a membrane, and afterwards a stony skin; nor can it have escaped any who have observed the track of a snail; that glistening substance, which it leaves on the floor or the wall, is no other than the materials with which the animal adds to its shell, or repairs it when broken.

Now, to exhibit, in a more satisfactory manner, the method in which the shell is formed—The snail bursts from its egg with its shell upon its back; this shell, though very simple, is the centre round which every succeeding convolution of the shell is formed, by new circles added to the first. As the body of the snail can be extended no where but to the aperture, the mouth of the shell only can, of consequence, receive augmentation. The substance of which the shell is composed is chiefly supplied by the animal itself, and is no more than a slimy fluid which hardens into bone. This fluid passes through an infinite number of little glands till it arrives at the pores of the skin; but there it is stopped by the shell that covers the part below; and, therefore, is sent to the mouth of the shell, where it is

wanted for its enlargement. There the first layer of slime soon hardens, and then another is added, which hardens also, till, in time, the shell becomes as thick as is requisite for the animal's preservation. Thus, every shell may be considered as composed of a number of layers of slime, which have entirely proceeded from the animal's own body.

But though this be the general opinion with regard to the formation of shells, I cannot avoid thinking there are still other substances, beside the animal's own slime which go to the composition of its shell, or, at least, to its external coat, which is ever different from the internal. The substances I mean, are the accidental concretions of earthy or saline parts, which add here to the slimy matter upon its first emission. By adopting this theory, we can more satisfactorily account for the various colours of the shell, which cannot be supposed to take its tincture from the animal's body, as is the usual opinion; for, all the internal parts of the shell are but of one white colour; it is only the uttermost layer of the shell that is so beautifully varied, so richly tinged with that variety of colours, we behold in the cabinets of the curious. If the external coat be scaled off, as Mr. Argenville asserts, all the inner substance will be found but of one simple colouring; and consequently, the animal's own juices can give only one colour; whereas we see some shells stained with a hundred.

The usual way of accounting for the different colouring of shells, which seem to me erroneous, is this. In the body of every one of these animals, several streaks are discerned of a different colour from the rest. This variety, say they, is an incontestible proof, that the juices flowing from those parts will be also of a different hue; and will consequently tinge that part of the shell which their slime composes of a different colour. But this system, as was observed before, is overthrown by the fact, which discovers that only the outward surface of the shell is tinged; whereas, by this, it would have been coloured throughout: nay, by this system, the internal parts of the shell would be stained with the most vivid colouring, as being least exposed to the external injuries of the element where it is placed.

But the truth is, the animal residing in the shell, has none of these various colours thus talked of : its slime is a simple pellucid substance ; and the only marblings which appear in its body, are the colour of the food, which is seen through its transparent intestines. We must, therefore, account for the various colouring of its shell, upon a different principle.

If, as I said, we examine the cabinets of the curious, we shall find shells with various and beautiful colouring ; we shall find them generally furnished with a white ground, tinged with red, yellow, brown, green, and several other shades and lovely mixtures, but never blue. Shells are of almost all colours but blue. The reason seems to be obvious ; for blue is the colour which sea-water changes. A piece of silk, or a feather, of this colour, put into an infusion of salt urine, or nitre, lose their tint entirely. Now, may not this give us a hint with respect to the operation of nature in colouring her shells ! may we not, from hence, conclude, that sea-water is efficacious in giving colour or taking it away ! that, to produce colour, the animal not only furnishes its juices, but the sea or the earth, that mixture of substance which is to unite with them. Neither the animal's slime alone, nor the external earthy or saline substances alone, could produce colours ; but both united, produce an effect which neither separately were possessed of. Thus, shells assume every colour but blue ; and that, sea-water, instead of producing, would be apt to destroy.

From hence, therefore, it appears, that the animal does not alone tincture its own shell ; but that external causes co-operate in contributing to its beauty. It is probable, that, from the nature of its food, or from other circumstances unknown to us, the external layers of its slime may be of different consistencies ; so as, when joined with the particles of earth or salt that are accidentally united with them from without, they assume various and beautiful hues. But the internal layers, which receive no foreign admixture, still preserve the natural colour of the animal, and continue white without any variation.

Thus far we see that the animal is not wholly the agent in

giving beauty and colouring to its shell : but it seems otherwise with respect to its convolutions, its prominences, and general form. These entirely depend upon the art of the animal ; or rather upon its instincts ; which, in the same kinds, are ever invariable. The shell generally bears some rude resemblance to the body upon which it has been moulded. Thus, it is observable in all sea-shells, that if the animal has any tumour or excrescence on its body, it creates likewise a swelling in that part of the incrustation to which it corresponds. When the animal begins to alter its position, and to make new additions to its apartments, the same protuberance which had raised the shell before in one part, swells it again at some little distance ; by which means, we see the same inequality, in a spiral line, all round the shell. Sometimes these tumours of the animal are so large, or so pointed, that those which rise over them in the incrustation, appear like horns : after this the animal disengages itself from its first cavities, and then, by fresh evacuations, assumes a new set of horns ; and so increases the number in proportion to its growth. If, on the other hand, the body happens to be channelled, the shell that covers it will be channelled likewise ; if there be any protuberances in the body, which wind in a spiral line about it, the shell will likewise have its tumours and cavities winding round to the end.

In this manner, as the animals are of various forms, the shells exhibit an equal variety. Indeed, the diversity is so great, and the figures and colours so very striking, that several persons, with a kind of harmless indolence, have made the arrangement of them the study and the business of their lives. Those who consult their beauty alone, take care to have them polished, and to have an external crust, or periosteum, as Swammerdam calls it, scoured off from their surfaces by spirit of salt. But there are others, that, with more learned affectation, keep them exactly in the state in which they have been found, with their precious crust still round them. The expense men have sometimes been at in making such collections, is amazing ; and some shells, such as the stairs shell or the admiral shell, are not more precious for their scarceness, than pearls are for



A Turbinated Shell.

9.



A Bivalve Shell.

9.



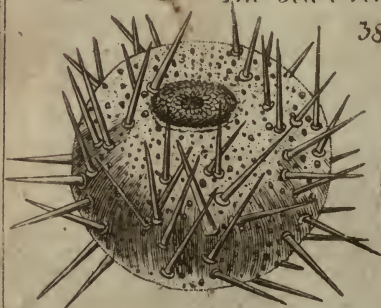
A Multivalve Shell.

9.



The Sea Urchins.

38.



Weston, jr.

their beauty. Indeed, it is the scarcity, and not the beauty, of the object, that determines the value of all natural curiosities. Those shells that offer but little beauty to the ignorant, are often the most precious; and those shells which an unlearned spectator would stop to observe with admiration, one accustomed to the visitation of cabinets, would pass over with disdain. These collections, however, have their use; not only by exhibiting the vast variety of nature's operations, but also by exciting our curiosity to the consideration of the animals that form them. A mind that can find innocent entertainment, in these humble contemplations, is well employed; and, as we say of children, is kept from doing mischief. Although there may be nobler occupations than that of considering the convolutions of a shell, yet there may be some who want the ambition to aspire after such arduous pursuits; there may be some unfit for them; there may be some who find their ambition fully gratified by the praise which the collectors of shells bestow upon each other. Indeed, for a day or two, there is no mind that a cabinet of shells cannot furnish with pleasing employment. What can be more gratifying, as Pliny says*, than to view nature in all her regularities, and sporting in her variety of shells! Such a difference of colour do they exhibit; such a difference of figure; flat, concave, long, lunated, drawn round in a circle, the orbit cut in two; some are seen with a rising on the back, some smooth, some wrinkled, toothed, streaked, the point variously intorted, the mouth pointing like a dagger, folded back, bent inwards; all these variations, and many more, furnish at once novelty, elegance and speculation.

With respect to the figure of shells, Aristotle has divided them into three kinds; and his method is of all others the most conformable to nature. These are, first, the univalve, or turbinated, which consist of one piece, like the box of a snail; secondly, the bivalve, consisting of two pieces, united by a hinge, like an oyster; and thirdly, the multivalve, consisting of more

* Plin. IX. 33.

than two pieces, as the acorn-shell, which has not less than twelve pieces that go to its composition. All these kinds are found in the sea at different depths; and are valuable in proportion to their scarceness or beauty.

From the variety of the colours and figure of shells, we may pass to that of their place and situation. Some are found in the sea; some in fresh-water rivers; some alive upon land; and still greater quantity dead in the bowels of the earth. But wherever shells are found, they are universally known to be composed of one and the same substance. They are formed of an animal or calcarious earth, that ferments with vinegar and other acids, and that burns into lime, and will not easily melt into glass. Such is the substance of which they are composed; and of their spoils, many philosophers think that a great part of the surface of the earth is composed at present. It is supposed by them, that chalks, marles, and all such earths as ferment with vinegar, are nothing more than a composition of shells, decayed and crumbled down to one uniform mass.

Sea-shells are either found in the depths of the ocean, or they are cast empty, and forsaken of their animals upon shore. Those which are fished up from the deep, are called by the Latin name *pelagii*; those that are cast upon shore, are called *littorales*. Many of the *pelagii* are never seen upon shore; they continue in the depth where they are bred; and we owe their capture only to accident. These, therefore, are the most scarce shells; and consequently, the most valuable. The *littorales* are more frequent; and such as are of the same kind with the *pelagii* are not so beautiful. As they are often empty and forsaken, and as their animal is dead, and perhaps putrid in the bottom of the shell, they by this means lose the whiteness and the brilliancy of their colouring. They are not unfrequently also found eaten through, either by worms, or by each other; and they are thus rendered less valuable: but what decreases their price still more is, when they are scaled and worn, by lying too long empty at the bottom, or exposed upon the shore. Upon the whole, however, sea-shells exceed either

land or fossil shells in beauty ; they receive the highest polish, and exhibit the most brilliant and various colouring.

Fresh-water shells are neither so numerous, so various, nor so beautiful as those belonging to the sea. They want that solidity which the others have ; their clavicle, as it is called, is neither so prominent nor so strong ; and not having a saline substance to tinge the surface of the shell, the colours are obscure. In fresh-water there are but two kinds of shells ; namely, the bivalved and the turbinated.

Living land shells are more beautiful, though not so various as those of fresh-water ; and some not inferior to sea shells in beauty. They are indeed but of one kind, namely, the turbinated ; but in that there are found four or five very beautiful varieties.

Of fossil, or, as they are called, *extraneous* shells, found in the bowels of the earth, there are great numbers, and as great a variety. In this class there are as many kinds as in the sea itself. There are found the turbinated, the bivalve, and the multivative kinds ; and of all these, many at present not to be even in the ocean. Indeed, the number is so great, and the varieties so many, that it was long the opinion of naturalists, they were merely the capricious productions of nature, and had never given retreat to animals whose habitations they resemble. They are found, not only of various kinds, but in different states of preservation : some had the shell entire composed, as in its primitive state, of a white calcareous earth, and filled with earth, or even empty ; others were found with the shell entire, but filled with a substance which was petrified by time ; others, and these in great numbers, were found with the shell entirely mouldered away, but the petrified substance that filled it, still exhibiting the figure of the shell ; others still, that had been lodged near the earth or stone, impressed their print upon these substances, and left the impression, though they themselves were decayed : lastly, some shells were found half mouldered away, their parts scaling off from each other in the same order in which they were originally formed. How-

ever, these different stages of the shell, and even their fermenting with acids, were at first insufficient to convince those who had before assigned them a different origin. They were still considered as accidentally and sportively formed, and deposited in the various repositories where they were found, but no way appertaining to any part of animated nature. This put succeeding enquirers upon more minute researches; and they soon began to find, that often where they dug up petrefied shells or teeth, they could discover the petrefied remains of some other bony parts of the body. They found, that the shells which were taken from the earth, exhibited the usual defects and mischances, which the same kind are known to receive at sea. They showed them not only tinctured with a salt-water crust, but pierced in a peculiar manner by the sea worms, that make the shells of fishes their favourite food. These demonstrations were sufficient at last to convince all but a few philosophers who died away, and whose erroneous systems died with them.

Every shell, therefore, wherever it is found, is now considered as the spoil of some animal, that once found shelter therein. It matters not by what unaccountable means they may have wandered from the sea; but they exhibit all, and the most certain marks, of their origin. From their numbers and situation, we are led to conjecture, that the sea reached the places where they are found; and from their varieties, we learn how little we know of all the sea contains at present; as the earth furnishes many kinds, which our most exact and industrious shell-collectors have not been able to fish up from the deep. It is most probable, that thousands of different forms still remain at the bottom unknown; so that we may justly say with the philosopher: *Ea quæ scimus sunt pars minima eorum quæ ignoramus.*

It is well, however, for mankind, that the defect of our knowledge on this subject, is, of all parts of learning, that which may be most easily dispensed with. An increase in the number of shells, would throw but very few lights upon the history of the animals that inhabit them. For such information, we are obliged to those men who contemplated something more than the outside of the objects before them. To

Reaumur we are obliged for examining the manners of some with accuracy; but to Swammerdam for more. In fact, this Dutchman has lent an attention to those animals, that almost exceeds credibility: he has excelled even the insects he dissected, in patience, industry, and perseverance. It was in vain that this poor man's father dissuaded him from what the world considered as a barren pursuit; it was in vain that a habitual disorder, brought on by his application, interrupted his efforts; it was in vain that mankind treated him with ridicule while living, as they suffered his works to remain long unprinted and neglected when dead: still the Dutch philosopher went on, peeping into unwholesome ditches, wading through fens, dissecting spiders, and enumerating the blood-vessels of a snail; like the bee, whose heart he could not only distinguish, but dissect, he seemed instinctively impelled by his ruling passion, although he found nothing but ingratitude from man, though his industry was apparently becoming fatal to himself. From him, I will take some of the leading features in the history of those animals which breed in shells; previously taking my division from Aristotle, who, as was said above, divides them into three classes: the turbinated, or those of the snail kind; the bivalved, or those of the oyster kind; and the multivalved, or those of the acorn-shell kind. Of each I will treat in distinct chapters.

C H A P. II.

Of Turbinated Shell-Fish of the Snail Kind.

TO conceive the manner in which those animals subsist that are hid from us at the bottom of the deep, we must again have recourse to one of a similar nature and formation, that we know. The history of the garden snail has been more copiously considered than that of the elephant;

and its anatomy is as well, if not better known : however, not to give any one object more room in the general picture of nature than it is entitled to, it will be sufficient to observe, that the snail is surprizingly fitted for the life it is formed to lead. It is furnished with the organs of life in a manner almost as complete as the largest animal ; with a tongue, brain, salival ducts, glands, nerves, stomach and intestines ; liver, heart and blood-vessels : besides this, it has a purple bag that furnishes a red matter, to different parts of the body, together with strong muscles that hold it to the shell, and which are hardened, like tendons, at their insertion.

But these it possesses in common with other animals. We must now see what it has peculiar to itself. The first striking peculiarity is, that the animal has got its eyes on the points of its largest horns. When the snail is in motion, four horns are distinctly seen ; but the two uppermost and longest deserve peculiar consideration, both on account of the various motions with which they are endued, as well as their having their eyes fixed at the extreme ends of them. These appear like two blackish points at their ends. When considered as taken out of the body, they are of a bulbous or turnip-like figure ; they have but one coat ; and the three humours which are common in the eyes of other animals, namely, the vitreous, the aqueous and the chrystaline, are in these very distinctly seen. The eyes the animal can direct to different objects at pleasure, by a regular motion out of the body ; and sometimes it hides them, by a very swift contraction into the belly. Under the small horns is the animal's mouth ; and though it may appear too soft a substance to be furnished with teeth, yet it has not less than eight of them, with which it devours leaves, and other substances, seemingly harder than itself ; and with which it sometimes bites off pieces of its own shell.

But what is most surprizing in the formation of this animal, are the parts that serve for generation. Every snail is at once male and female ; and while it impregnates another, is itself impregnated in turn. The vessels, supplying the fluid for this

purpose, are placed chiefly in the fore part of the neck, and extend themselves over the body; but the male and the female organs of generation, are always found united, and growing together. There is a large opening on the right side of the neck, which serves for very different purposes. As an anus, it gives a passage to the excrements; as a mouth, it serves for an opening for respiration; and also as an organ of generation, it dilates when the desire of propagation begins. Within this, each animal has those parts, or something similar thereto, which continue the kind.

For some days before coition, the snails gather together, and lie quiet near each other, eating very little in the mean time; but they settle their bodies in such a posture, that the neck and the head are placed upright. In the mean time, the apertures on the side of the neck, being greatly dilated, two organs, resembling intestines, are seen issuing from them, which some have thought to be the instruments of generation. Beside the protrusion of these, each animal is possessed of another peculiarity; for, from the same aperture, they launch forth a kind of dart at each other, which is pretty hard, barbed, and ending in a very sharp point. This is performed when the apertures approach each other; and then the one is seen to shoot its weapon, which is received by the other, though it sometimes falls to the ground: some minutes after, the snail which receives the weapon, darts one of its own at its antagonist, which is received in like manner. They then softly approach still nearer, and apply their bodies one to the other, as closely as the palms and fingers of the hands, when grasped together. At that time the horns are seen variously moving in all directions; and this sometimes for three days together. The coupling of these animals is generally thrice repeated, at intervals of fifteen days each; and, at every time, a new dart is mutually emitted.

At the expiration of eighteen days, the snails produce their eggs, at the opening of the neck, and hide them in the earth with the greatest solicitude and industry. These eggs are in great numbers, round, white, and covered with a soft shell:

they are also stuck to each other by an imperceptible slime, like a bunch of grapes, of about the size of a small pea.

When the animal leaves the egg, it is seen with a very small shell on its back, which has but one convolution; but in proportion as it grows, the shell increases in the number of its circles. The shell always receives its additions at the mouth; the first centre still remaining: the animal sending forth from its body that slime which hardens into a stony substance, and still is fashioned into similar convolutions. The garden snail seldom exceeds four rounds and a half; but some of the sea snails arrive even at ten.

The snail, thus fitted with its box, which is light and firm, finds itself defended in a very ample manner from all external injury. Whenever it is invaded, it is but retiring into this fortress, and waiting patiently till the danger is over. Nor is it possessed only of a power of retreating into its shell; but of mending it when broken. Sometimes these animals are crushed seemingly to pieces; and, to all appearance, utterly destroyed: yet still they set themselves to work, and, in a few days, mend all their numerous breaches. The same substance by which the shell is originally made, goes to the re-establishment of the ruined habitation. But all the junctures are very easily seen, for they have a fresher colour than the rest, and the whole shell, in some measure, resembles an old coat, patched with new pieces. They are sometimes seen with eight or ten of these patches; so that the damage must have been apparently irreparable. Still, however, **though** the animal is possessed of the power of mending its **shell**, it cannot, when come to its full growth, make a new one. Swammerdam tried the experiment: he stripped a snail of its shell, without hurting any of the blood vessels, retaining that part of the shell where the muscles were inserted; but it died in three days after it was stripped of its covering: not, however, without making efforts to build up a new shell; for, before its death, it pressed out a certain membrane round the whole surface of its body. This membrane was entirely of the shelly nature; and was intended, by the animal, as a supply towards a new one.

As the snail is furnished with all the organs of life, and sensation, it is not wonderful to see it very voracious. It chiefly subsists upon the leaves of plants and trees; but is very delicate in its choice. When the animal moves to seek its food, it goes forward by means of that broad muscular skin which sometimes is seen projecting round the mouth of the shell; this is expanded before, and then contracted with a kind of undulating motion, like a man attempting to move himself forward by one arm, while lying on his belly. But the snail has another advantage, by which it not only smooths and planes its way, but also can ascend in the most perpendicular direction. This is by that slimy substance with which it is so copiously furnished, and which it emits wherever it moves. Upon this slime, as upon a kind of carpet, it proceeds slowly along, without any danger of wounding its tender body against the asperities of the pavement; by means of this, it moves upwards to its food upon trees; and by this descends, without danger of falling, and breaking its shell by the shock.

The appetite of these animals is very great; and the damage gardeners in particular sustain from them, makes them employ every method for their destruction. Salt will destroy them, as well as foot; but a tortoise in a garden, is said to banish them much more effectually.

At the approach of winter, the snail buries itself in the earth; or retires to some hole, to continue in a torpid state, during the severity of the season. It is sometimes seen alone; but more frequently in company in its retreat; several being usually found together, apparently deprived of life and sensation. For the purposes of continuing in greater warmth and security, the snail forms a cover or lid to the mouth of its shell with its slime, which stops it up entirely, and thus protects it from every external danger. The matter of which the cover is composed, is whitish, somewhat like plaister, pretty hard and solid, yet, at the same time, porous and thin, to admit air, which the animal cannot live without. When the cover is formed too thick, the snail then breaks a little hole in it, which corrects the defect of that closeness, which proceeded from too much cau-

tion. In this manner, sheltered in its hole from the weather, defended in its shell by a cover, it sleeps during the winter; and, for six or seven months, continues without food or motion, until the genial call of spring breaks its slumber, and excites its activity.

The snail having slept for so long a season, wakes one of the first fine days of April; breaks open its cell, and sallies forth to seek for nourishment. It is not surprizing that so long a fast should have thinned it, and rendered it very voracious. At first, therefore, it is not very difficult in the choice of its food: almost any vegetable that is green, seems welcome; but the succulent plants of the garden are chiefly grateful; and the various kind of pulse are, at some seasons, almost wholly destroyed by their numbers. So great is the multiplication of snails at some years, that gardeners imagine they burst from the earth. A wet season is generally favourable to their production; for this animal cannot bear very dry seasons, or dry places, as they cause too great a consumption of its slime, without plenty of which it cannot subsist in health and vigour.

Such are the most striking particulars in the history of this animal; and this may serve as a general picture, to which the manners and habitudes of the other tribes of this class may be compared and referred. These are, the sea snail, of which naturalists have, from the apparent difference of their shells, mentioned fifteen kinds*; the fresh-water snail, of which there are eight kinds; and the land snail, of which there are five. These all bear a strong resemblance to the garden snail, in the formation of their shell, in their hermaphrodite natures, in the slimy substance with which they are covered, in the formation of their intestines, and the disposition of the hole on the right side of the neck, which serves at once for the discharge of the fæces, for the lodging the instruments of generation, and for respiration, when the animal is under a necessity of taking in a new supply.

But in nature, no two kinds of animals, however like each

* D'Argenville's Conchyliologie.

other in figure or conformation, are of manners entirely the same. Though the common garden snail bears a very strong resemblance to that of fresh-water, and that of the sea, yet there are differences to be found, and those very considerable ones.

If we compare them with the fresh-water snail, though we shall find a general resemblance, yet there are one or two remarkable distinctions: and first, the fresh-water snail, and, as I should suppose, all snails that live in water are peculiarly furnished with a contrivance by nature, for rising to the surface, or sinking to the bottom. The manner in which this is performed, is by opening and shutting the orifice on the right side of the neck, which is furnished with muscles for that purpose. The snail sometimes gathers this aperture into an oblong tube, and stretches or protends it above the surface of the water, in order to draw in or expel the air, as it finds occasion. This may not only be seen, but heard also by the noise which the snail makes in moving the water. By dilating this it rises; by compressing it the animal sinks to the bottom. This is effected somewhat in the manner in which little images of glass are made to rise or sink in water, by pressing the air contained at the mouth of the tubes, so that it shall drive the water into their hollow bodies, which before were filled only with air, and thus make them heavier than the element in which they swim. In this manner does the fresh-water snail dive or swim, by properly managing the air contained in its body.

But what renders these animals far more worthy of notice is, that they are viviparous, and bring forth their young not only alive, but with their shells upon their backs. This seems surprizing; yet it is incontestibly true: the young come to some degree of perfection in the womb of the parent; there they receive their stony coat; and from thence are excluded, with a complete apparatus for subsistence.

“ On the twelfth of March,” says Swammerdam, “ I began my observations upon this snail, and collected a great number of the kind, which I put into a large basin filled with rain-wa-

ter, and fed for a long time with potter's earth, dissolved in the water about them. On the thirteenth of the same month, I opened one of these snails, when I found nine living snails in its womb : the largest of these were placed foremost, as the first candidates for exclusion. I put them into fresh-water, and they lived to the eighteenth of the same month, moving and swimming, like snails full grown : nay, their manner of swimming was much more beautiful." Thus, at whatever time of the year these snails are opened, they are found pregnant with eggs, or with living snails ; or with both together.

This striking difference between the fresh-water and the garden snail, obtains also in some of the sea kind ; among which there are some that are found viviparous, while others lay eggs in the usual manner. Of this kind, are one or two of the buccinums ; within which living young have been frequently found, upon their dissection. In general, however, the rest of this numerous class bring forth eggs ; from whence the animal bursts at a proper state of maturity, completely equipped with a house, which the moistness of the element where it resides does not prevent the inhabitant from enlarging. How the soft slime of the snail hardens, at the bottom of the sea, into the stony substance of a shell, is not easy to conceive ! This slime must at least be possessed of very powerful petrifying powers.

All animals of the snail kind, as was observed before, are hermaphrodites ; each containing the instruments of generation double. But some of the sea kinds, copulate in a different manner from those of the garden. The one impregnates the other ; but, from the position of the parts, is incapable of being impregnated by the same in turn. For this reason, it is necessary for a third to be admitted as a partner in this operation ; so that, while one impregnates that before it, another does the same office by this ; which is itself impregnated by a fourth. In this manner, mr. Anderson has seen vast numbers of sea snails, united together in a chain, impregnating each other. The *bulin* and the *corret* perform the offices of male and female

at the same time. The orifices in these are two, both separate from each other : the opening by which the animal performs the office of the male, being at the origin of the horns ; that by which it is passive as the female, being farther down upon the neck. It may also be observed as a general rule, that all animals that have this orifice, or verge, as some call it, on the right side, have their shells turned from the right to the left ; on the contrary, those which have it on the left side, have their shells turned from left to right, in a contrary direction to the former.

But this is not the only difference between land and sea snails. Many of the latter entirely want horns ; and none of them have above two. Indeed, if the horns of snails be furnished with eyes, and if, as some are willing to think, the length of the horn, like the tube of a telescope, assists vision, these animals, that chiefly reside in the gloomy bottom of the deep, can have no great occasion for them. Eyes would be unnecessary to creatures whose food is usually concealed in the darkest places ; and who, possessed of very little motion, are obliged to grope for what they subsist on. To such, I say, eyes would rather be an obstruction than an advantage ; and, perhaps, even those that live upon land are without them !

Those that have seen the shells of sea snails, need not be told that the animal which produces them is larger than those of the same denomination upon land. The sea seems to have the property of enlarging the magnitude of all its inhabitants ; and the same proportion that a trout bears to a shark, is often seen to obtain between a shell bred upon the land, and one bred in the ocean. Its convolutions are more numerous. The garden snail has but five turns at the most ; in the sea snail the convolutions are sometimes seen amounting to ten.

There is a difference also in the position of the mouth, in the garden and the water snail. In the former, the mouth is placed crosswise, as in quadrupeds ; furnished with jaw-bones, lips, and teeth. In most of the sea snails, the mouth is placed longitudinally in the head ; and, in some, obliquely, or on one side. Others, of the trochus kind, have no mouth whatsoever ;

but are furnished with a trunk, very long in some kinds, and shorter in others.

Snails of the trochus kind, furnished thus with an instrument of offence, deserve our particular attention. The trunk of the trochus is fleshy, muscular, supple, and hollow. Its extremity is bordered with a cartilage, and toothed like a saw. The snails that are provided with this, may be considered as the predacious tribe, among their fellows of the bottom. They are, among snails, what the tiger, the eagle, or the shark is among beasts, birds, or fishes. The whole race of shell animals avoid their approach ; for their habitations, however powerfully and strongly built, though never so well fortified, yield to the superior force of these invaders. Though provided with a thick clumsy shell themselves, yet they move with greater swiftness at the bottom than most other shell fish ; and seize their prey with greater facility. No shell so large but they will boldly venture to attack ; and, with their piercing augre-like trunk, will quickly bore it through. No efforts the other animal makes can avail ; it expands itself, and rises to the surface ; but the enemy rises with it ; it again sinks to the bottom, but still its destroyer closely adheres. In this manner the carnivorous shell-fish, as some naturalists call it, sticks for several days, nay weeks, to its prey, until, with its trunk, it has sucked out all substance, or until it drops off, when the other begins to putrefy.

Thus it would seem throughout nature, that no animal is so well defended, but that others are found capable of breaking in upon its entrenchments. The garden snail seems tolerably well guarded ; but the wall of its shell is paper itself, in comparison with that which fortifies some of the sea snail kind. Beside this thick shell, many of them are also furnished with a lid, which covers the mouth of the shell, and which opens and shuts at the animal's pleasure. When the creature hunts for food, it opens its box, gropes or swims about ; and, when satisfied, drops its lid and sinks to the bottom ; there it might be supposed to remain in perfect security ; but the trochus

soon finds the way to break into the thickest part of its enclosure, and quickly destroys it with the most fatal industry.

The being liable to the attacks of the trochus seems to be a calamity to which most of this tribe are subject. Scarce a shell is met with entire and sound to the end of its convolutions; but particularly the thinnest shells are the most subject to be thus invaded. As their shells are easily pierced, the predatory shell-fish, or the sea-worm, chiefly seek them for subsistence; and of those thin paper-like shells, not one in a hundred is found that has not suffered some disaster. As they are lighter than other shell-fish, they swim with greater ease; and this is the chief method of avoiding their heavier thick shelled pursuers. The food of all snails properly lies at the bottom; when, therefore, the nautilus, or other thin shelled fish, are seen busily swimming at the surface, it may be, that, instead of sporting or sunning themselves, as some are apt to suppose, they are actually labouring to escape their most deadly pursuers.

Of all sea snails, that which is most frequently seen swimming upon the surface, and whose shell is the thinnest and most easily pierced, is the nautilus. Whether, upon these occasions, it is employed in escaping its numerous enemies at the bottom, or seeking for food at the surface, I will not venture to decide. It seems most probable, that the former is the cause of its frequently appearing; for, upon opening the stomach, it is found to contain chiefly that food which it finds at the bottom. This animal's industry, therefore, may be owing to its fears; and all those arts of sailing, which it has taught mankind, may have been originally the product of necessity. But the nautilus is too famous not to demand a more ample description.

Although there be several species of the nautilus, yet they all may be divided into two: the one with a white shell, as thin as paper, which it often is seen to quit, and again to resume; the other with a thicker shell, sometimes of a beautiful mother-of pearl colour, and that quits its shell but rarely. This shell outwardly resembles that of a large snail, but is generally

six or eight inches across : within, it is divided into forty partitions, that communicate with each other by doors, if I may so call them, through which one could not thrust a goose-quill : almost the whole internal part of the shell is filled by the animal ; the body of which, like its habitation, is divided into as many parts as there are chambers in its shell ; all the parts of its body communicate with each other, through the doors or openings, by a long blood-vessel, which runs from the head to the tail : thus the body of the animal, if taken out of the shell, may be likened to a number of soft bits of flesh, of which there are forty, threaded upon a string. From this extraordinary conformation, one would not be apt to suppose that the nautilus sometimes quitted its shell, and returned to it again : yet nothing, though seemingly more impossible, is more certain. The manner by which it contrives to disengage every part of its body from so intricate an habitation ; by which it makes a substance, to appearance, as thick as one's wrist, pass through forty doors, each of which would scarcely admit a goose-quill, is not yet discovered ; but the fact is certain ; for the animal is often found without its shell ; and the shell more frequently destitute of the animal. It is most probable, that it has a power of making the substance of one section of its body, remove up into that which is next ; and thus, by multiplied removals, it gets free.

But this, though very strange, is not the peculiarity for which the nautilus has been the most distinguished. Its spreading the thin oar, and catching the flying gale, to use the poet's description of it, has chiefly excited human curiosity. These animals, particularly those of the white, light kind, are chiefly found in the Mediterranean ; and scarce any who have sailed on that sea, but must often have seen them. When the sea is calm, they are observed floating on the surface ; some spreading their little sail ; some rowing with their feet, as if for life and death ; and others still floating upon their mouths, like a ship with the keel upward. If taken while thus employed, and examined, the extraordinary mechanism of their limbs for sailing will appear more manifest. The nautilus is furnished with

eight feet, which issue near the mouth, and may as properly be called barbs: these are connected to each other by a thin skin, like that between the toes of a duck, but much thinner and more transparent. Of these eight feet thus connected, six are short, and these are held up as sails to catch the wind in sailing: the two others are longer, and are kept in the water; serving, like paddles, to steer their course by. When the weather is quite calm, and the animal is pursued from below, it is then seen expanding only a part of its sail, and rowing with the rest; whenever it is interrupted, or fears danger from above, it instantly furls the sail, catches in all its oars, turns its shell mouth downward, and instantly sinks to the bottom. Sometimes also it is seen pumping the water from its leaking hulk; and, when unfit for sailing, deserts its shell entirely. The forsaken hulk is seen floating along, till it dashes, by a kind of shipwreck, upon the rocks or the shore.

From the above description, I think we may consider this animal rather as attempting to save itself from the attacks of its destroyers, than as rowing in pursuit of food. Certain it is, that no creature of the deep has more numerous and more powerful enemies. Its shell is scarcely ever found in perfect preservation; but is generally seen to bear some marks of hostile invasion. Its little arts, therefore, upon the surface of the water, may have been given it for protection; and it may be thus endued with comparative swiftness, to avoid the crab, the sea-scorpion, the trochus, and all the slower predacious reptiles that lurk for it at the bottom of the water.

From this general view of snails, they appear to be a much more active, animated tribe, than from their figure one would at first conceive. They seem, to an inattentive spectator, as mere inert masses of soft flesh, rather loaded than covered with a shell, scarcely capable of motion, and insensible to all the objects around them. When viewed more closely, they are found to be furnished with the organs of life and sensation in tolerable perfection; they are defended with armour, that is at once both light and strong; they are as active as their necessities re-

quire ; and are possessed of appetites more poignant than those of animals that seem much more perfectly formed. In short, they are a fruitful industrious tribe ; furnished, like all other animals, with the powers of escape and invasion ; they have their pursuits and their enmities ; and, of all creatures of the deep, they have most to fear from each other.

C H A P. III.

Of Bivalved Shell-Fish, or Shells of the Oyster Kind.

IT may seem whimsical to make a distinction between the animal perfections of turbinated and bivalved shell-fish, or to grant a degree of superiority to the snail above the oyster. Yet this distinction strongly and apparently obtains in nature ; and we shall find the bivalved tribe of animals, in every respect, inferior to those we have been describing. Inferior in all their sensations ; inferior in their powers of motion ; but particularly inferior in their system of animal generation. The snail tribe, as we saw, are hermaphrodite, but require the assistance of each other for fecundation ; all the bivalve tribe are hermaphrodite in like manner, but they require no assistance from each other towards impregnation ; and a single muscle or oyster, if there were no other in the world, would quickly replenish the ocean. As the land snail, from its being best known, took the lead in the former class, so the fresh-water muscle, for the same reason, may take lead in this. The life and manners of such as belong to the sea, will be best displayed in the comparison.

The muscle, as is well known, whether belonging to fresh or salt-water, consists of two equal shells, joined at the back by a strong muscular ligament that answers all the purposes of a hinge. By the elastic contraction of these, the animal can open its shells, at pleasure, about a quarter of an inch from each other. The fish is fixed to either shell by four tendons, by means

of which it shuts them close, and keeps its body firm from being crushed by any shock against the walls of its own habitation. It is furnished, like all other animals of this kind, with vital organs, though these are situated in a very extraordinary manner. It has a mouth furnished with two fleshy lips; its intestine begins at the bottom of the mouth, passes through the brain, and makes a number of circumvolutions through the liver; on leaving this organ, it goes on straight into the heart, which it penetrates, and ends in the anus; near which the lungs are placed, and through which it breathes, like those of the snail kind; and in this manner its languid circulation is carried on*.

But the organs of generation are what most deserve to excite our curiosity. These consist, in each muscle, of two ovaries, which are the female part of its furniture, and of two seminal vessels resembling what are found in the male. Each ovary and each seminal vessel has its own proper canal; by the ovary canal the eggs descend to the anus; and there also the seminal canals send their fluids to impregnate them. By this contrivance, one single animal suffices for the double purposes of generation; and the eggs are excluded and impregnated by itself alone.

As the muscle is thus furnished with a kind of self-creating power, there are few places where it breeds, that it is not to be found in great abundance. The ovaries usually empty themselves of their eggs in spring, and they are replenished in autumn. For this reason, they are found empty in summer and full in winter. They produce in great numbers, as all bivalved shell-fish are found to do. The fecundity of the snail kind is trifling in comparison to the fertility of these. Indeed, it may be asserted as a general rule in nature, that the more helpless and contemptible the animal, the more prolific it is always found. Thus all creatures that are incapable of resisting their destroyers, have nothing but their quick multiplication for the continuation of their existence.

* M. Mery, Anat. de Moules d'Etang.

The multitude of these animals, in some places, is very great; but, from their defenceless state, the number of their destroyers are in equal proportion. The crab, the cray-fish, and many other animals, are seen to devour them; but the trochus is their most formidable enemy. When their shells are found deserted, if we then observe closely, it is most probable we shall find that the trochus has been at work in piercing them. There is scarce one of them without a hole in it; and this probably was the avenue by which the enemy entered to destroy the inhabitant.

But notwithstanding the number of this creature's animated enemies, it seems still more fearful of the agitations of the element in which it resides; for, if dashed against rocks, or thrown far on the beach, it is destroyed without a power of redress. In order to guard against these, which are to this animal the commonest and most fatal accidents, although it has a power of slow motion, which I shall presently describe, yet it endeavours to become stationary, and to attach itself to any fixed object it happens to be near. For this purpose, it is furnished with a very singular capacity of binding itself by a number of threads to whatever object it approaches; and these Reaumur supposed it spun artificially, as spiders their webs which they fasten against a wall. Of this, however, latter philosophers have found very great reason to doubt. It is, therefore, supposed, that these threads, which are usually called the beard of the muscle, are the natural growth of the animal's body, and by no means produced at pleasure. Indeed, the extreme length of this beard in some, which far exceeds the length of the body, seems impossible to be manufactured by the thrusting out and drawing in of the tongue, with the glutinous matter of which the French philosopher supposed those threads were formed. It is even found to increase with the growth of the animal; and as the muscle becomes larger and older, the beard becomes longer and its filaments more strong*.

* Mercier du Paty, sur le bouchots à moules. Tom. ii. de l'Academie de la Rochelle.

Be this as it will, nothing is more certain, than that the muscle is found attached by these threads, to every fixed object ; sometimes, indeed, for want of such an object, these animals are found united to each other ; and though thrown into a lake separately, they are taken out in bunches of many together.

To have some fixed resting place where the muscle can continue, and take in its accidental food, seems the state that this animal chiefly desires. Its instrument of motion, by which it contrives to reach the object it wants to bind itself to, is that muscular substance resembling a tongue, which is found long in proportion to the size of the muscle. In some it is two inches long, in others not a third part of these dimensions. This the animal has a power of thrusting out of its shell ; and with this it is capable of making a slight furrow in the sand at the bottom. By means of this furrow it can erect itself upon the edge of its shell ; and thus, continuing to make the furrow in proportion as it goes forward, it reaches out its tongue, that answers the purpose of an arm, and thus carries its shell edge-ways, as in a groove, until it reaches the point intended. There, where it determines to take up its residence, it fixes the ends of its beard, which are glutinous, to the rock or the object, whatever it be ; and thus, like a ship at anchor, braves all the agitations of the water. Sometimes the animal is attached by a large number of threads ; sometimes but by three or four, that seem scarce able to retain it. When the muscle is fixed in this manner, it lives upon the little earthy particles that the water transports to its shells, and perhaps the flesh of the most diminutive animals. However, it does not fail to grow considerably ; and some of this kind have been found a foot long. I have seen the beards a foot and a half ; and of this substance, the natives of Palermo sometimes make gloves and stockings.

These shell fish are found in lakes, rivers, and in the sea. Those of the lake often grow to a very large size ; but they seem a solitary animal, and are found generally separate from each other. Those of rivers are not so large, but yet in greater abun-

dance ; but the sea muscle, of all others, is perhaps the most plenty. These are often bred artificially in salt-water marshes that are overflowed by the tide ; the fishermen throwing them in at the proper seasons ; and there being undisturbed by the agitations of the sea, and not preyed upon by their powerful enemies at the bottom, they cast their eggs, which soon become perfect animals, and these are generally found in clusters of several dozens together. It requires a year for the peopling a muscle-bed ; so that, if the number consists of forty thousand, a tenth part may annually be left for the peopling the bed anew. Muscles are taken from their beds from the month of July to October ; and they are sold at a very moderate price.

From this animal, the oyster differs very little except in the thickness of its shell, and its greater imbecility. The oyster, like the muscle, is formed with organs of like respiration, with intestines which are very voluminous, a liver, lungs and heart. Like the muscle, it is self-impregnated ; and the shell, which the animal soon acquires, serves it for its future habitation. Like the muscle, it opens its shell, to receive the influx of water ; and, like that animal, is strongly attached to its shell both above and below.

But it differs in many particulars. In the first place, its shells are not equal, the one being cupped, the other flat ; upon the cupped shell it is always seen to rest ; for if it lay upon the flat side it would then lose all its water. It differs also in the thickness of its shells, which are so strongly lined and defended, that no animal will attempt to pierce them. But though the oyster be secured from the attacks of the small reptiles at the bottom, yet it often serves as an object to which they are attached. Pipe-worms and other little animals fix their habitation to the oyster's sides, and in this manner continue to live in security. Among the number of these is a little red worm, that is often found upon the shell ; which some, from never seeing oysters copulate, erroneously supposed to be the male by which their spawn was impregnated.

The oyster differs also from the muscle in being utterly un-

able to change its situation. The muscle, as we have observed, is capable of erecting itself on an edge, and going forward with a slow laborious motion. The oyster is wholly passive, and endeavours, by all its powers, to rest fixed to one spot at the bottom. It is entirely without that tongue which we saw answering the purposes of an arm in the other animal; but, nevertheless, is often attached very firmly to any object it happens to approach. Rocks, stones, pieces of timber, or sea-weeds, all seem proper to give it a fixture, and to secure it against the agitation of the waves. Nothing is so common in the rivers of the tropical climates as to see oysters growing even amidst the branches of the forest. Many trees which grow along the banks of the stream, often bend their branches into the water, and particularly the mangrove, which chiefly delights in a moist situation. To these the oysters hang in clusters, like apples upon the most fertile tree; and in proportion as the weight of the fish sinks the plant into the water, where it still continues growing, the number of oysters increase, and hang upon the branches. Thus there is nothing that these shell fish will not stick to; they are often even found to stick to each other. This is effected by means of a glue proper to themselves, which, when it cements, the joining is as hard as the shell, and is as difficultly broken. The joining substance, however, is not always of glue; but the animal grows to the rocks, somewhat like the muscle, by threads; although these are only seen to take root in the shell, and not, as in the muscle, to spring from the body of the fish itself.

Oysters usually cast their spawn in May, which at first appear like drops of candle-grease, and stick to any hard substance they fall upon. These are covered with a shell in two or three days; and in three years the animal is large enough to be brought to market. As they invariably remain in the places where they are laid, and as they grow without any other seeming food than the afflux of sea-water, it is the custom at Colchester, and other parts of the kingdom, where the tide settles in marshes on land, to pick up great quantities of small oysters along the shore, which, when first gathered, seldom exceed the size of a sixpence.

These are deposited in beds where the tide comes in, and in two or three years grow to a tolerable size. They are said to be better tasted for being thus sheltered from the agitations of the deep; and a mixture of fresh-water entering into these repositories, is said to improve their flavour, and to increase their growth and fatness.

The oysters, however, which are prepared in this manner, are by no means so large as those found sticking to rocks at the bottom of the sea, usually called rock-oysters. These are sometimes found as broad as a plate, and are admired by some as excellent food. But what is the size of these, compared to the oysters of the East-Indies, some of whose shells I have seen two feet over! The oysters found along the coast of Coromandel are capable of furnishing a plentiful meal to eight or ten men; but it seems universally agreed that they are no way comparable to ours for delicacy or flavour.

Thus the muscle and the oyster appear to have but few distinctions except in their shape and the power of motion in the former. Other bivalved shell-fish, such as the cockle, the scallop, and the razor shell, have differences equally minute. The power of changing place, which some of them effect in a manner quite peculiar to themselves, makes their greatest difference. The scallop is particularly remarkable for its method of moving forward upon land, or swimming upon the surface of the water. When this animal finds itself deserted by the tide, it makes very remarkable efforts to regain the water, moving towards the sea in a most singular manner. It first gapes with its shell as widely as it can, the edges being often an inch asunder; then it shuts them with a jerk, and by this the whole animal rises five or six inches from the ground. It thus tumbles any how forward, and then renews the operation until it has attained its journey's end. When in the water, it is capable of supporting itself upon the surface, and there opening and shutting its shells, it tumbles over and over, and makes its way with some celerity.

The pivot or razor shell has a very different kind of motion.

As the former moves laboriously and slowly forward, so the razor shell has only a power of sinking point downward. The shells of this animal resemble nothing so much as the haft of a razor; and by this form it is better enabled to dive into the soft sand at the bottom. All the motions of this little animal are confined to sinking or rising a foot downwards or upwards in the sand, for it never leaves the spot where first it was planted. From time to time it is seen to rise about half way out of its hole; but if any way disturbed, it sinks perpendicularly down again. Just over the place where the razor buries itself, there is a small hole like a chimney, through which the animal breathes, or imbibes the sea-water. Upon the desertion of the tide, these holes are easily distinguished by the fishermen who seek for it; and their method enticing the razor up from the depth of its retreat is by sprinkling a little sea-salt upon the hole. This melting no sooner reaches the razor below, than it rises instantly straight upwards, and shows about half its length above the surface. This appearance however is instantaneous; and if the fisher does not seize the opportunity, the razor buries itself with great ease to its former depth. There it continues secure; no salt can allure it a second time; but it remains unmolested, unless the fisher will be at the trouble of digging it out sometimes two feet below the surface.

Such are the minute differences between bivalved shell-fish; but in the great out-lines of their nature they exactly resemble each other. It is particularly in this class of shell-fish that pearls are found in great abundance; and it is in the internal parts of those shells that are of a shining silvery colour that these gems are usually generated; but the pearl is also found to breed as well in the muscle or the scallop as in the oyster. In fact, it is found in all bivalved shells, the insides of which resemble that well known substance called mother-of-pearl.

Whether pearls be a disease or an accident in the animal is scarce worth enquiry. The common opinion is, that they are a kind of calculous concretion in the body of the animal, somewhat resembling a stone in the bladder, and are consequently

to be considered as a disorder. It is said, in confirmation of this opinion, that those coasts upon which pearls are fished are very unhealthy; and therefore most probably oysters share the general influence of the climate; it is also added that those oysters in which pearls are found are always ill-tasted, which is a sign of their being unsound; and lastly, it is asserted that the pearl grows sometimes so big as to keep the shells of the animal from shutting, and that thus it dies by being exposed. It is easy to see the weakness of these assertions, which seem neither true nor amusing. To answer them in their own way, if a stone in the bladder be a disorder, a stone in the stomach of an ostrich is a benefit, and so it may be in the shell of an oyster. If the shores where the pearls are fished be unwholesome to man, that, instead of being disadvantages, is so much the more lucky for the oyster. If the pearl oysters are the worst tasted, so are kites and ravens among birds; and yet we know that they are healthy and long-lived animals: if the oyster had ever its shell kept asunder by the pearl within it, that would be a disease indeed: but this, in reality, never happens; for the oyster that breeds a large pearl always breeds a large shell, and the shell itself indents to receive its impression. The pearl, upon the whole, seems bred from no disorder in the animal, but accidentally produced by the same matter that goes to form the shell. This substance, which is soft at first, quickly hardens; and thus, by successive coats, layer over layer, the pearl acquires its dimensions. If cut through, it will be found to consist of several coats, like an onion; and sometimes a small speck is seen in the middle, upon which the coats were originally formed.

All oysters, and most shell fish, are found to contain pearls; but that which particularly obtains the name of the pearl oyster, has a large strong whitish shell, wrinkled and rough without, and within, smooth and of a silver colour. From these the mother-of-pearl is taken, which is nothing more than the internal coats of the shell, resembling the pearl in colour and consistence. This is taken out and shaped into the variety of utensils which are found so beautiful; but the pearl itself is chiefly prized; being found but in few oysters, and generally

adhering, sometimes making a print in the body of the shell, sometimes at large within the substance of the fish.

There are a great number of pearl fisheries in America and Asia; but as pearls bear a worse price than formerly, those of America are in a great measure discontinued. The most famous of all the Asiatic fisheries is in the Persian gulph, near the isle of Bahren. There is another between the coast of Madura and the island of Ceylon; and there was a third on the coasts of Japan; but as these noble islanders have a contempt for jewels, and an abhorrence for such Europeans as come in pursuit of them, that fishery, which is thought to be the most valuable of all others, is discontinued. The diving business is now carried on only in those countries where the wretchedness of one part of mankind goes to support the magnificence of the other.

The chief fishery, as was said, is carried on in the Persian Gulph, and the most valuable pearls are brought from thence. The value of these jewels increases not only in proportion to their size but also their figure and colour; for some pearls are white, others are yellowish, others of a lead colour; and some affirm they have been found as black as jet. What it is that gives these different tinctures to pearls is not known; Taverner ascribes it to their lying two or three weeks upon shore after the oyster is taken; Reaumur thinks it proceeds from the colour of that part of the fish's body upon which the pearl lies. It is most probably that this colour proceeds, like the spots frequently found on the internal surface of the shell itself, from some accident while the pearl is growing.

The best coloured pearls and the roundest, are brought from the East; those of America are neither so white nor so exactly oval. All pearls, however, in time, become yellow; they may be considered as an animal substance, converted into a stony hardness, and like ivory, taking a tincture from the air. They have been even found to decay when kept in damp or vaulted places, and to moulder into a substance scarce harder than chalk. When the daughters of Stilicon, who were both betrothed, one after the other, to the emperor Honorius, were bu-

ried, much of their finery was also deposited with them in the same tomb. In this manner they remained buried for above eleven hundred years, till the foundations of the church of St. Peter were laying. Their tomb was then discovered, and all their finery was found in tolerable preservation, except their pearls, which were converted by time and damps into a chalky powder.

The wretched people that are destined to fish for pearls, are either Negroes or some of the poorest of the natives of Persia. The inhabitants of this country are divided into tyrants and slaves. The divers are not only subject to the dangers of the deep, to tempests, to suffocation at the bottom, to being devoured by sharks, but from their profession, universally labour under a spitting of blood, occasioned by the pressure of air upon their lungs in going down to the bottom. The most robust and healthy young men are chosen for this employment, but they seldom survive it above five or six years. Their fibres become rigid; their eye-balls turn red; and they usually die consumptive.

It is amazing how very long they are seen to continue at the bottom. Some, as we have been assured, are known to continue for three-quarters of an hour under water without breathing; and to one unused to diving, ten minutes would suffocate the strongest. Whether from some effort the blood bursts the old passage which it had in the foetus, and circulates without going through the lungs, it is not easy to tell; but certain it is, that some bodies have been dissected with this canal of communication open, and these extraordinary divers may be internally formed in that manner.

Be this as it may, no way of life seems so laborious, so dangerous, or so painful. They fish for pearls, or rather the oysters that contain them, in boats twenty-eight feet long; and of these there are sometimes three or four hundred at a time, with each seven or eight stones, which serve for anchors. There are from five to eight divers belonging to each, that dive one after another. They are quite naked, except that they have a net hanging down from the neck to put their oysters in, and gloves on

their hands to defend them while they pick the oysters from the holes in the rocks; for in this manner alone can they be gathered. Every diver is sunk by means of a stone, weighing fifty pounds, tied to the rope by which he descends. He places his foot in a kind of stirrup, and laying hold of the rope with his left hand, with the right he stops his nose to keep in his breath, as upon going down he takes in a very long inspiration. They are no sooner come to the bottom, but they give the signal to those who are in the boat to draw up the stone; which done, they go to work; filling their net as fast as they can; and then giving another signal, the boats above pull up the net loaded with oysters, and shortly after the diver himself to take a new inspiration. They dive to the depth of fifteen fathoms, and seldom go deeper. They generally go every morning by break of day to this fatiguing employment, taking the land wind to waft them out to sea, and returning with the sea breeze at night. The owners of the boats usually hire the divers and the rest of the boats' crew, as we do our labourers, at so much a day. All the oysters are brought on shore, where they are laid in a great heap till the pearl fishery is over, which continues during the months of November and December. When opportunity serves, they then examine every oyster, and it is accidental whether the capture turns out advantageous. Indeed, no human being can with well to a commerce, which thus chains such a number of fellow creatures to the bottom, to pluck up a glittering mouldering pebble.

C H A P. IV.

Of Multivalve Shell-Fish.

MULTIVALVE shell-fish may be considered as animals shut up in round boxes. To view their habitations externally, one would be little apt to consider them as the retreats of living creatures; and still less, to suppose that some of them carry their boxes with a tolerable share of swiftness, so as to

escape their pursuers. Of these, there are principally two kinds; such as move, and such as are stationary: the first are usually known in our cabinets by the name of sea-eggs; the others are as often admired, from the cavities which they scoop out for their habitation in the hardest marble. The first are called by naturalists, echini, or urchins; the latter are called pholades, or file fish. Of both there are several sorts; but by describing these two, we shall have a competent idea of all the rest.

To a slight view, the sea urchin may be compared to the husk of a chestnut; being like it round, and with a number of bony prickles standing out on every side. To exhibit this extraordinary animal in every light—if we could conceive a turnip stuck full of pins on every side, and running upon these pins with some degree of swiftness, we should have some idea of this extraordinary creature. The mouth is placed downwards; the vent is above; the shell is a hollow vase, resembling a scooped apple; and this filled with a soft muscular substance, through which the intestines wind from the bottom to the top. The mouth, which is placed undermost, is large and red, furnished with five sharp teeth, which are easily discerned. The jaws are strengthened by five small bones, in the centre of which is a small fleshy tongue; and from this the intestines make a winding of five spires, round the internal sides of the shell, ending at top, where the excrements are excluded. But what makes the most extraordinary part of this animal's conformation, are its horns and its spines, that point from every part of the body, like the horns of a snail, and that serve, at once, as legs to move upon, as arms to feel with, and as instruments of capture and defence. Between these horns it has also spines that are not endued with such a share of motion. The spines and the horns issue from every part of its body; the spines being hard and prickly; the horns being soft, longer than the spines, and never seen except in the water. They are put forward and withdrawn like the horns of a snail, and are hid at the bases of the spines, serving, as was said before, for procuring food and motion. All this apparatus, however, is only seen when the animal is hunting its prey at the bottom of the water; for a

few minutes after it is taken, all the horns are withdrawn into the body, and most of the spines drop off.

It is generally said of insects, that those which have the greatest number of legs, almost move the slowest: but this animal seems to be an exception to the rule; for though furnished with two thousand spines, and twelve hundred horns, all serving for legs, and from their number, seeming to impede each other's motion, yet it runs with some share of swiftness at the bottom, and it is sometimes no easy matter to overtake it. It is often taken upon the ebb, by following it in shallow water, either in an ozier basket, or simply with the hand. Both the spines and the horns assist its motion; and the animal is usually seen running with the mouth downward.

Some kinds of this animal are as good eating as the lobster; and its eggs, which are of a deep red, are considered as a very great delicacy. But of others the taste is but indifferent; and in all places except the Mediterranean, they are little sought for, except as objects of curiosity.

Very different in motion, though not much different in shape from these, are the acorn-shell-fish, the thumb-footed shell fish, and the imaginary barnacle. These are fixed to one spot, and appear to vegetate from a stalk. Indeed, to an inattentive spectator, each actually seems to be a kind of fungus that grows in the deep, destitute of animal life as well as motion. But the enquirer will soon change his opinion, when he comes to observe this mushroom-like figure more minutely. He will then see that the animal residing within the shell has not only life, but some degree of voraciousness; that it has a cover, by which it opens and shuts its shell at pleasure; that it has twelve long crooked arms, furnished with hair, which it thrusts forth for its prey; and eight smaller, which are generally kept in the shell. They are seen adhering to every substance that is to be met with in the ocean; rocks, roots of trees, ships' bottoms, whales, lobsters, and even crabs; like bunches of grapes, clung to each other. It is amusing enough to behold their operations*. They for some time remain motionless within their

* Anderson's History of Greenland.

shell ; but when the sea is calm, they are seen opening the lid, and peeping about them. They then thrust out their long neck, look round them for some time, and then abruptly retreat back into their box, shut their lid, and lurk in darkness and security. Some people eat them ; but they are in no great repute at the tables of the luxurious, where their deformed figure would be no objection to their being introduced.

Of all animals of the shelly tribe, the pholades are the most wonderful. From their great powers of penetration, compared with their apparent imbecility, they justly excite the astonishment of the curious observer. These animals are found in different places ; sometimes clothed in their proper shell, at the bottom of the water ; sometimes concealed in lumps of marly earth ; and sometimes lodged, shell and all, in the body of the hardest marble. In their proper shell they assume different figures ; but, in general, they somewhat resemble a muscle, except that their shell is found actually composed of five or more pieces, the smaller valves serving to close up the openings left by the irregular meeting of the two principal shells. But their penetration into rocks, and their residence there, makes up the most wonderful part of their history.

This animal, when divested of its shell, resembles a roundish, soft pudding, with no instrument that seems in the least fitted for boring into stones, or even penetrating the softest substances. It is furnished with two teeth indeed ; but these are placed in such a situation, as to be incapable of touching the hollow surface of its stony dwelling : it has also two covers to its shell, that open and shut at either end ; but these are totally unserviceable to it as a miner. The instrument with which it performs all its operations, and buries itself in the hardest rocks, is only a broad fleshy substance, somewhat resembling a tongue, that is seen issuing from the bottom of its shell. With this soft, yielding instrument, it perforates the most solid marbles ; and having, while yet little and young, made its way, by a very narrow entrance, into the substance of the stone, it then begins to grow bigger, and thus to enlarge its apartment.

The seeming unsuitness, however, of this animal for pene-

trating into rocks, and there forming an habitation, has induced many philosophers to suppose that they entered the rock while it was yet in a soft state, and from the petrifying quality of the water, that the whole rock afterwards hardened round them by degrees. Thus any penetrating quality, it was thought, was unjustly ascribed to them, as they only bored into a soft substance, that was hardened by time. This opinion, however, has been confuted, in a very satisfactory manner, by doctor Bohads, who observed, that many of the pillars of the temple of Serapis, at Puteoli, were penetrated by these animals. From thence he very justly concludes, that the pholas must have pierced into them since they were erected; for no workman would have laboured a pillar into form, if it had been honey-combed by worms in the quarry. In short, there can be no doubt but that the pillars were perfectly sound when erected; and that the pholades have attacked them, during that time in which they continued buried under water, by means of the earthquake that swallowed up the city*.

From hence it appears, that, in all nature, there is not a greater instance of perseverance and patience than what this animal is seen to exhibit. Furnished with the bluntest and softest augre, by slow, successive applications, it effects what other animals are incapable of performing by force; penetrating the hardest bodies only with its tongue. When, while yet naked and very small, it has effected an entrance, and has buried its body in the stone, it there continues for life at its ease; the seawater that enters at the little aperture supplying it with luxurious plenty. When the animal has taken too great a quantity of water, it is seen to spurt it out of its hole with some violence. Upon this seemingly thin diet, it quickly grows larger and larger, and soon finds itself under the necessity of enlarging its habitation and its shell. The motion of the pholas is slow beyond conception; its progress keeps pace with the growth of its body; and, in proportion as it becomes larger, it makes its way farther into the rock. When it has got a certain way in, it

* Bohadsch de Animalibus Marinis, p. 153.

then turns from its former direction, and hollows downward; till, at last, when its habitation is completed, the whole apartment resembles the bole of a tobacco pipe; the hole in the flank being that by which the animal entered.

Thus immured, the pholas lives in darkness, indolence and plenty; it never removes from the narrow mansion into which it has penetrated: and seems perfectly content with being inclosed in its own sepulchre. The influx of the sea-water, that enters by its little gallery, satisfies all its wants; and without any other food, it is found to grow from seven to eight inches long, and thick in proportion.

But they are not supplied only with their rocky habitation; they have also a shell to protect them: this shell grows upon them in the body of the rock, and seems a very unnecessary addition to their defence, which they have procured themselves by art. These shells take different forms, and are often composed of a different number of valves; sometimes six; sometimes but three; sometimes the shell resembles a tube with holes at either end, one for the mouth, and the other for voiding the excrements.

Yet the pholas thus shut up, is not so solitary an animal as it would at first appear; for though it is immured in its hole without egress, though it is impossible for the animal, grown to a great size, to get out by the way it made in, yet many of this kind often meet in the heart of the rock, and, like miners in a siege, who sometimes cross each other's galleries, they frequently break in upon each other's retreats. Whether their thus meeting, be the work of accident, or of choice, few can take upon them to determine; certain it is, they are most commonly found in numbers in the same rock; and sometimes above twenty are discovered within a few inches of each other.

As to the rest, this animal is found in greatest numbers at Ancona, in Italy; it is found along the shores of Normandy and Poitou, in France; it is found also upon some of the coasts of Scotland: and, in general, is considered as a very great delicacy at the tables of the luxurious.

O F

F R O G S, L I Z A R D S,

A N D

S E R P E N T S.

C H A P. I.

Of Frogs and Toads in General.

IF we emerge from the deep, the first and most obvious class of amphibious animals that occur upon land are frogs and toads. These, wherever they reside, seem equally adapted for living upon land and in the water, having their hearts formed in such a manner as to dispense with the assistance of the lungs in carrying on the circulation. The frog and toad, therefore, can live several days under water, without any danger of suffocation; they want but little air at the bottom; and, what is wanting, is supplied by lungs, like bladders, which are generally distended with wind, and answer all the purposes of a reservoir from whence to breathe.

To describe the form of animals so well known, would be superfluous; to mark those differences that distinguish them from each other, may be necessary. The frogs move by leaping; the toad crawls along the ground: the frog is, in general, less than the toad; its colour is brighter, and with a more polished surface: the toad is brown, rough and dusty. The frog is light and active, and its belly comparatively small; the toad is slow, swollen, and incapable of escaping. The frog, when taken, contracts itself so as to have a lump on its back; the

toad's back is straight and even. Their internal parts are nearly the same, except that the lungs of the toad are more compact than those of the frog; they have fewer air-bladders, and of consequence, the animal is less fitted for living under water. Such are the differences with respect to figure and conformation; their habitudes and manners exhibit a greater variety, and require a separate description.

C H A P. II.

Of the Frog, and its Varieties.

THE external figure of the frog is too well known to need a description. Its power of taking large leaps is remarkably great, compared to the bulk of its body. It is the best swimmer of all four-footed animals; and nature hath finely adapted its parts for those ends, the arms being light and active, the legs and thighs long, and furnished with very strong muscles.

If we examine this animal internally, we shall find that it has a very little brain for its size: a very wide swallow; a stomach seemingly small, but capable of great distention. The heart in the frog, as in all other animals that are truly amphibious, has but one ventricle; so that the blood can circulate without the assistance of the lungs, while it keeps under water. The lungs resemble a number of small bladders joined together like the cells of a honey-comb: they are connected to the back by muscles, and can be distended or exhausted at the animal's pleasure. The male has two testiculi lying near the kidneys; and the female has two ovaries, lying near the same place; but neither male nor female have any of the external instruments of generation; the anus serving for that purpose in both. Such are the most striking peculiarities in the anatomy of a frog; and in these it agrees with the toad, the lizard, and the fer-

pent. They are all formed internally, pretty much in the same manner, with spongy lungs, a simple heart, and are destitute of the external instruments that serve to continue the kind.

Of all those who have given histories of the frog, mr. Ræsel, of Nurembergh, seems the most accurate and entertaining. His plates of this animal are well known; his assiduity and skilfulness in observing its manners, are still more deserving our esteem. Instead, therefore, of following any other, I will take him for my guide; and though it be out of my power to amuse the reader with his beautiful designs, yet, there will be some merit in transcribing his history.

The common brown frog begins to couple early in the season, and as soon as the ice is thawed from the stagnating waters. In some places, the cold protracts their genial appetite till April; but it generally begins about the middle of March. The male is usually of a greyish brown colour; the female is more inclining to yellow, speckled with brown. When they couple, the colours of both are nearly alike on the back; but as they change their skins almost every eighth day, the old one falling off, in the form of a mucus, the male grows yellower, and the female more brown. In the males, the arms and legs are much stronger than in the females; and, at the time of coupling, they have upon their thumbs, a kind of fleshy excrescence, which they fix firmly to the breast of the female. This Linnæus supposed to be the male instrument of generation; but, by closer inspection, it is found only of service in holding the female in a more strict embrace. It may be cut off, and the impregnation continue unimpaired: it is sometimes found in the opposite sex; and some of the males are found entirely without it: however, when it is cut off, the male cannot hold the female so strongly as before.

The sex couple only once a year; and then continue united sometimes for four days together. At this time they both have their bellies greatly swollen; that of the female being filled with eggs: the male having the skin of the whole body distended with a limpid water, which is ejected in impregna-

tion. As soon as the male has leaped upon the female, he throws his fore legs round her breast, and closes them so firmly that it is impossible with the naked hands to loose them. The male clasps his fingers between each other, in the same manner as people when they are praying; the thumbs press with their thickest sides against the breast of the female; and though she should struggle ever so much, nothing can induce him to let go his hold. The grasp seems involuntary and convulsive; they cannot be easily torn asunder; and they swim, creep, and live united for some days successively, till the female has shed her spawn, which at length she does almost in an instant. But how the impregnation is performed, without any apparent instruments of generation, has long been an object of enquiry; and still continues in great obscurity. To investigate the difficulty as carefully as possible, our German philosopher continued to examine their mutual congress for three years together, and availed himself of all the lights that the knife, or analogy, could furnish.

After having chosen twelve couple of frogs that were thus joined to each other, and having placed each couple in a glass vessel with water, he scarce let them out of his sight day or night, and even sat up two nights together to examine their operations. The first day he observed nothing that deserved remark; but the second they began to be agitated more than before: the males made a noise somewhat resembling the grunting of a hog; the females only kept sinking and rising in the water.

The male of the first couple ejected the humidity with which his body was swollen, by which the water in the glass was made muddy; and soon after quitted the female. Our philosopher continued for twelve hours to observe whether the female would cast her spawn; but finding her tardy, he dissected both her and the male; in the latter, the spermatic vessels were quite empty, as might naturally have been supposed; but for the female, her spawn still remained in her body. Upon its being extracted, and put into water, it perished without

producing any animal whatever. From hence he justly concluded, that it required that the eggs should be ejected from the female before they could be at all prolific. In another pair the male quitted the female, who did not eject her spawn till sixteen days after; and these, like the former, came to nothing. But it was very different with some of the rest. The females ejected their spawn, while the male still remained in his station, and impregnated the masses at different intervals as they fell from her; and these all brought forth animals in the usual course of generation. From these observations it was easy to infer, that the female was impregnated neither by the mouth, as some philosophers imagined, nor by the excrescence at the thumbs, as was the opinion of Linnæus, but by the inspersion of the male seminal fluid upon the eggs, as they proceeded from the body.

A single female produces from six to eleven hundred eggs at a time; and, in general, she throws them all out together by a single effort; though sometimes she is an hour in performing this task. While she is thus bringing forth, it may be observed, that the male acts the part of a midwife, and promotes the expulsion of the eggs by working with his thumbs, and compressing the female's body more closely. The eggs which were compressed in the womb, upon being emitted, expand themselves into a round form, and drop to the bottom of the water, while the male swims off, and strikes with his arms as usual, though they had continued so long in a state of violent contraction.

The egg, or little black globe, which produces a tadpole, is surrounded with two different kinds of liquor. That which immediately surrounds the globe is clear and transparent, and contained in its proper membrane; that which surrounds the whole is muddy and mucous. The transparent liquor serves for the nourishment of the tadpole from time to time; and answers the same purposes that the white of the egg does to birds. The tadpoles, when this membrane is broken, are found to adhere with their mouth to part of it: and when they get free, they immediately sink to the bottom of the water, never being able

to get to the top after, while they continue in their tadpole form.

But to return—When the spawn is emitted and impregnated by the male, it drops, as was said, to the bottom, and there the white quickly and insensibly creases. The eggs, which during the four first hours suffer no perceptible change, begin then to enlarge and grow lighter; by which means they mount to the surface of the water. At the end of eight hours, the white in which they swim grows thicker, the eggs lose their blackness, and, as they increase in size, somewhat of the spherical form. The twenty-first day the egg is seen to open a little on one side, and the beginning of a tail to peep out, which becomes more and more distinct every day. The thirty-ninth day the little animal begins to have motion; it moves at intervals its tail; and it is perceived that the liquor in which it is circumfused, serves it for nourishment. In two days more, some of these little creatures fall to the bottom; while others remain swimming in the fluid around them, their vivacity and motion being seen to increase. Those which fall to the bottom remain there the whole day; but having lengthened themselves a little, for hitherto they are doubled up, they mount at intervals to the mucus which they had quitted, and are seen to feed upon it with great vivacity. The next day they acquire their tadpole form. In three days more, they are perceived to have two little fringes, that serve as fins beneath the head; and these in four days afterwards assume a more perfect form. It is then also that they are seen to feed very greedily upon the pond weed with which they are to be supplied; and, leaving their former food, on this they continue to subsist till they arrive at maturity. When they come to be ninety-two days old, two small feet are seen beginning to burgeon near the tail; and the head appears to be separate from the body. The next day, the legs are considerably enlarged; four days after they refuse all vegetable food; their mouth appears furnished with teeth; and their hinder legs are completely formed. In two days more, the arms are completely produced; and now the frog is every way perfect, except that it still continues to carry the tail. In this odd situation, the ani-

animal, resembling at once both a frog and a lizard, is seen frequently rising to the surface, not to take food but to breathe. In this state it continues for about six or eight hours; and then the tail dropping off by degrees, the animal appears in its most perfect form.

Thus the frog, in less than a day, having changed its figure, is seen to change its appetites also. So extraordinary is this transformation, that the food it fed upon so greedily but a few days before, is now utterly rejected; it would even starve if supplied with no other. As soon as the animal acquires its perfect state, from having fed upon vegetables, it becomes carnivorous, and lives entirely upon worms and insects. But as the water cannot supply these, it is obliged to quit its native element, and seek for food upon land, where it lives by hunting worms, and taking insects by surprize. At first, being feeble, and unable to bear the warmth of the sun, it hides among bushes and under stones; but when a shower comes to refresh the earth, then the whole multitude are seen to quit their retreats, in order to enjoy the grateful humidity. Upon many occasions, the ground is seen perfectly blackened with their numbers; some hunting for prey, and some seeking secure lurking places. From the myriads that offer on such occasions, some have been induced to think, that these animals were generated in the clouds, and thus showered down on the earth. But had they, like Derham, traced them to the next pool, they would have found out a better solution for the difficulty.

The frog lives for the most part out of the water; but when the cold nights begin to set in, it returns to its native element, always choosing stagnant waters, where it can lie without danger concealed at the bottom. In this manner it continues torpid, or with but very little motion, all the winter: like the rest of the dormant race, it requires no food; and the circulation is slowly carried on without any assistance from the air.

It is at the approach of spring, that these animals are roused from a state of slumber, to a state of enjoyment. A short time after they rise from the bottom, they begin to pair, while

those that are as yet too young, come upon land before the rest. For this reason, while the old ones continue concealed in the beginning of spring, the small ones are more frequently seen; the former remaining in the lake to propagate, while the latter are not yet arrived at a state of maturity.

The difference of sexes, which was mentioned above, is not perceivable in these animals, until they have arrived at their fourth year; nor do they begin to propagate, till they have completed that period. By comparing their slow growth with their other habitudes, it would appear, that they live about twelve years; but having so many enemies, both by land and water, it is probable, that few of them arrive at the end of their term.

Frogs live upon insects of all kinds; but they never eat any, unless they have motion. They continue fixed and immoveable, till their prey appears; and just when it comes sufficiently near, they jump forward with great agility, dart out their tongues, and seize it with certainty. The tongue in this animal, as in the toad, lizard, and serpent kinds, is extremely long, and formed in such a manner, that it swallows the point down its throat; so that a length of tongue is thus drawn out, like a sword from its scabbard, to assail its prey. This tongue is furnished with a glutinous substance; and whatever insect it touches, infallibly adheres, and is thus held fast, till it is drawn into the mouth.

As the frog is thus supplied with the power of catching its prey, it is also very vivacious, and able to bear hunger for a very long time. I have known one of them continue a month in summer, without any other food, than the turf on which it was placed in a glass vessel. We are told of a German surgeon, that kept one eight years, in a glass vessel, covered with a net. Its food was at all times but sparing; in summer he gave it fresh grass, which it is said to have fed upon; and, in the winter, hay, a little moistened: he, likewise, now and then, put flies into the glass, which it would follow with an open mouth, and was very expert in catching them. In winter, when flies were difficult to be found, it usually fell away, and grew very





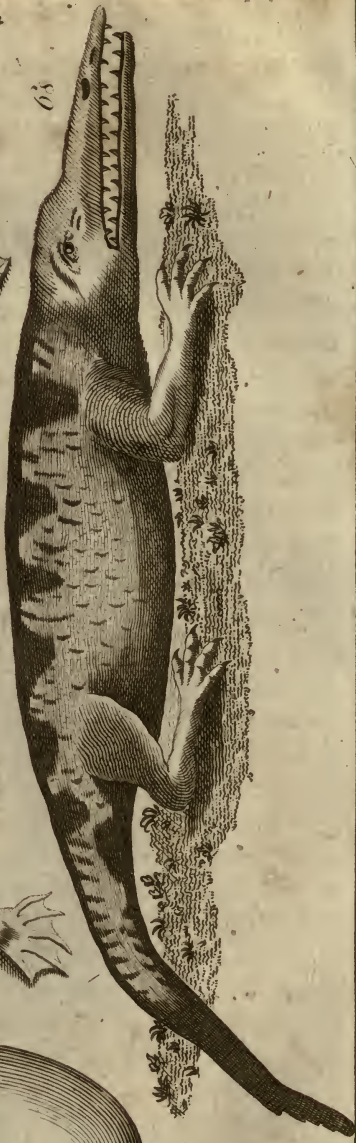
Crocodile's Egg



Bull Frog



Pipal



Crocodile

lean; but, in the summer, when they were plenty, it soon grew fat again. It was kept in a warm room, and was always lively and ready to take its prey; however, in the eighth winter, when there were no flies to be found, it fell away, and died. It is not certain how long it might have lived, had it been supplied with proper nourishment; but we are certain that a very little food is capable of supplying its necessities.

Nor is the frog less tenacious of life. It will live and jump about several hours after its head has been cut off. It will continue active, though all its bowels are taken out; and it can live some days, though entirely stripped of its skin. This, cruel trick, which is chiefly practised among school-boys, of skinning frogs, an operation which is done in an instant, seems, for some hours, no way to abate their vigour. I am assured that some of them get a new skin, and recover, after this painful experiment.

The croaking of frogs is well known; and from thence, in some countries, they are distinguished by the ludicrous title of Dutch nightingales. Indeed, the aquatic frogs of Holland, are loud beyond what one would imagine. We could hardly conceive, that an animal, not bigger than one's fist, should be able to send forth a note, that is heard at three miles distance; yet such is actually the case*. The large water frogs have a note as loud as the bellowing of a bull; and for this purpose, puff up their cheeks to a surprizing magnitude. Of all frogs, however, the male only croaks; the female is silent, and the voice in the other, seems to be the call to courtship. It is certain, that at these times, when they couple, the loudness of their croaking is in some places very troublesome; for then the whole lake seems vocal; and a thousand dissonant notes perfectly stun the neighbourhood. At other times, also, before wet weather, their voices are in full exertion; they are then heard with unceasing assiduity, sending forth their call, and welcoming the approaches of their favourite moisture. No weather-glass was ever so true as a frog, in foretelling an approach-

* Rafel, *ibid.*

ing change ; and, in fact, the German surgeon, mentioned above, kept his frog for that purpose. It was always heard to croak at the approach of wet weather ; but was as mute as a fish, when it threatened a continuance of fair. This may, probably, serve to explain an opinion which some entertain, that there is a month in the year, called paddock-moon, in which the frogs never croak : the whole seems to be no more, than that, in the hot season, when the moisture is dried away, and consequently, when these animals neither enjoy the quantity of health nor food, that at other times they are supplied with, they shew, by their silence, how much they are displeased with the weather. All very dry weather is hurtful to their health, and prevents them from getting their prey. They subsist chiefly upon worms and snails ; and as drought prevents these from appearing, the frog is thus stinted in its provisions, and also wants that grateful humidity which moistens its skin, and renders it alert and active.

As frogs adhere closely to the backs of their own species, so it has been found, by repeated experience, they will also adhere to the backs of fishes. Few that have ponds, but know that these animals will stick to the backs of carp, and fix their fingers in the corner of each eye. In this manner they are often caught together ; the carp blinded and wasted away. Whether this proceeds from the desires of the frog, disappointed of its proper mate, or whether it be a natural enmity between frogs and fishes, I will not take upon me to say. A story told us by Walton, might be apt to incline us to the latter opinion.

“ As Dubravius, a bishop of Bohemia, was walking with a friend, by a large pond in that country, they saw a frog, when a pike lay very sleepily and quiet by the shore side, leap upon his head, and the frog having expressed malice or anger by his swollen cheeks and staring eyes, did stretch out his legs, and embraced the pike’s head, and presently reached them to his eyes, tearing, with them and his teeth, those tender parts ; the pike, irritated with anguish, moves up and down the water, and rubs himself against weeds, and whatever he thought might

quit him of his enemy ; but all in vain, for the frog did continue to ride triumphantly, and to bite and torment the pike till his strength failed, and then the frog sunk with the pike to the bottom of the water : then presently the frog appeared again at the top, and croaked, and seemed to rejoice like a conqueror ; after which he presently retired to his secret hole. The bishop that had beheld the battle, called his fisherman to fetch his nets, and by all means to get the pike, that they might declare what had happened. The pike was drawn forth, and both his eyes eaten out ; at which, when they began to wonder, the fisherman wished them to forbear, and assured them, that he was certain, that pikes were often so served."

C H A P. III.

Of the Toad, and its Varieties.

IF we regard the figure of the toad, there seems nothing in it that should disgust more than that of the frog. Its form and proportions are nearly the same ; and it chiefly differs in colour, which is blacker ; and its slow and heavy motion, which exhibits nothing of the agility of the frog : yet such is the force of habit, begun in early prejudice, that those who consider the one as a harmless, playful animal, turn from the other with horror and disgust. The frog is considered as a useful assistant, in ridding our grounds of vermin ; the toad, as a secret enemy, that only wants an opportunity to infect us with its venom.

The imagination, in this manner, biassed by its terrors, paints out the toad in the most hideous colouring, and clothes it in more than natural deformity. Its body is broad ; its back flat ; covered with a dusky, pimpled hide ; the belly is large and swagging ; the pace laboured and crawling ; its retreat gloomy and filthy, and its whole appearance calculated to excite disgust and horror : yet, upon my first seeing a toad, none, of all

these deformities, in the least affected me with sensations of loathing: born, as I was, in a country where there are no toads, I had prepared my imagination for some dreadful object; but there seemed nothing to me more alarming in the sight, than in that of a common frog; and, indeed, for some time, I mistook, and handled the one for the other. When first informed of my mistake, I very well remember my sensations: I wondered how I had escaped with safety, after handling and dissecting a toad, which I had mistaken for a frog. I then began to lay in a fund of horror against the whole tribe, which, though convinced they are harmless, I shall never get rid of. My first imaginations were too strong, not only for my reason, but for the conviction of my senses.

As the toad bears a general resemblance of figure to the frog, so, also, it resembles that animal in its nature and appetites. Like the frog, the toad is amphibious; like that animal, it lives upon worms and insects, which it seizes by darting out its length of tongue; and in the same manner, also, it crawls about in moist weather. The male and female couple as in all the frog kind; their time of propagation being very early in the spring. Sometimes the females are seen upon land, oppressed by the males, but more frequently they are coupled in the water. They continue together some hours, and adhere so fast, as to tear the very skin from the parts they stick to. In all this, they entirely resemble the frog; but the assistance which the male lends the female, in bringing forth, is a peculiarity in this species that must not be passed over in silence. “In the evening of a summer’s day, a French gentleman, being in the king’s gardens, at Paris, perceived two toads coupled together, and he stopped to examine them. Two facts, equally new, surprised him: the first was the extreme difficulty the female had in laying her eggs: the second was the assistance lent her by the male, for this purpose. The eggs of the female lie in her body, like beads on a string; and after the first, by great effort, was excluded, the male caught it with his hinder paws, and kept working it till he had thus extracted the whole chain. In this manner the animal performed, in some measure, the func-

tions of a midwife; impregnating, at the same time, every egg as it issued from the body."

It is probable, however, that this difficulty in bringing forth, obtains only upon land; and that the toad, which produces its spawn in the water, performs it with as much ease as a frog. They propagate in England, exactly in the manner of frogs; and the female, instead of retiring to dry holes, goes to the bottom of ponds, and there lies torpid all the winter, preparing to propagate in the beginning of spring. On these occasions, the number of males is found greatly to surpass that of the other sex, there being above thirty to one; and twelve or fourteen are often seen clinging to the same female.

When, like the frog, they have undergone all the variations of their tadpole state, for they forsake the water; and are often seen, in a moist summer's evening, crawling up by myriads, from fenny places, into drier situations. There, having found out a retreat, or having dug themselves one with their mouth and hands, they lead a patient, solitary life, seldom venturing out, except when the moisture of a summer's evening invites them abroad. At that time the grass is filled with snails, and the pathways covered with worms, which make their principal food. Insects also of every kind they are fond of; and we have the authority of Linnæus for it, that they sometimes continue immoveable with their mouth open, at the bottom of shrubs, where the butterflies, in some measure fascinated, are seen to fly down their throats*.

In a letter from Mr. Arscott, there are some curious particulars, relating to this animal, which throws great light upon its history. "Concerning the toad," says he, "that lived so many years with us, and was so great a favourite, the greatest curiosity was, its becoming so remarkably tame: it had frequented some steps before our hall door, some years before my acquaintance commenced with it, and had been admired by my father for its size (being the largest I ever met with) who

* *Amanit.* vol. iv, p. 201.

constantly paid it a visit every evening. I knew it myself above thirty years; and by constantly feeding it, brought it to be so tame, that it always came to the candle, and looked up, as if expecting to be taken up, and brought upon the table, where I always fed it with insects of all sorts. It was fondest of flesh maggots, which I kept in bran; it would follow them, and when within a proper distance, would fix his eyes and remain motionless, for near a quarter of a minute, as if preparing for the stroke, which was an instantaneous throwing its tongue at a great distance upon the insect, which stuck to the tip by a glutinous matter. The motion is quicker than the eye can follow. I cannot say how long my father had been acquainted with the toad, before I knew it; but, when I was first acquainted with it, he used to mention it as the old toad I have known so many years. I can answer for thirty-six years. This old toad made its appearance as soon as the warm weather came; and I always concluded it retired to some dry bank, to repose till spring. When we new-layed the steps, I had two holes made in the third step, on each with a hollow of more than a yard long for it; in which, I imagine, it slept, as it came from thence at its first appearance. It was seldom provoked. Neither that toad, nor the multitudes I have seen tormented with great cruelty, ever showed the least desire of revenge, by spitting or emitting any juice from their pimples. Sometimes, upon taking it up, it would let out a great quantity of clear water, which, as I have often seen it do the same upon the steps, when quite quiet, was certainly its urine, and no more than a natural evacuation. Spiders, millepedes, and flesh maggots, seem to be this animal's favourite food. I imagine if a bee was to be put before a toad, it would certainly eat it to its cost*; but as bees are seldom stirring at the same time that toads are, they rarely come in their way; as they do not appear after sun-rising, or before sun-set. In the heat of the day, they will come to the mouth of their hole, I believe, for air. I once, from my parlour window, observed a large toad I had in the bank of a

* Ræsel tried a frog; it swallowed the bee alive; its stomach was stung, and the animal vomited it up again.

bowling-green, about twelve at noon, a very hot day, very busy and active upon the grass. So uncommon an appearance made me go out to see what it was; when I found an innumerable swarm of winged ants had dropped round his hole; which temptation was as irresistible as a turtle would be to a luxurious alderman. In respect to its end, had it not been for a tame raven, I make no doubt but it would have been now living. This bird, one day seeing it at the mouth of its hole, pulled it out, and, although I rescued it, pulled out one eye, and hurt it so, that notwithstanding its living a twelve-month, it never enjoyed itself, and had a difficulty of taking its food, missing the mark, for want of its eye. Before that accident, it had all the appearance of perfect health."

To this account of the toad's inoffensive qualities, I will add another from Valisnieri, to show that, even taken internally, the toad is no way dangerous. "In the year 1692, some German soldiers, who had taken possession of the castle of Arceti, finding that the peasants of the country often amused themselves in catching frogs, and dressing them for the table, resolved to provide themselves with a like entertainment, and made preparations for frog-fishing, in the same manner. It may easily be supposed, that the Italians and their German guests were not very fond of each other; and, indeed, it is natural to think, that the soldiers gave the poor people of the country many good reasons for discontent. They were not a little pleased, therefore, when they saw them go to a ditch where toads instead of frogs were found in abundance. The Germans, no way distinguishing, in their sport, caught them in great numbers; while the peasants kept looking on, silently flattering themselves with the hopes of speedy revenge. After being brought home, the toads were dressed up, after the Italian fashion; the peasants quite happy at seeing their tyrants devour them with so good an appetite, and expecting every moment to see them drop down dead: but what was their surprize to find, that the Germans continued as well as ever, and only complained of a slight excoriation of the lips, which

probably arose from some other cause than that of their repast."

I will add another story, from Solenander ; who tells us, that a tradesman of Rome and his wife had long lived together with mutual discontent ; the man was dropfical, and the woman amorous : this ill-matched society promised soon, by the very infirm state of the man, to have an end ; but the woman was unwilling to wait the progress of the disorder ; and therefore concluded that, to get rid of her husband, nothing was left her but poison. For this purpose, she chose out a dose that she supposed would be the most effectual ; and having calcined some toads, mixed their powder with his drink. The man, after taking a hearty dose, found no considerable inconvenience, except that it greatly promoted urine. His wife, who considered this as a beginning symptom of the venom, resolved not to stint the next dose, but gave it in greater quantities than before. This also increased the former symptom ; and in a few days, the woman had the mortification to see her detested husband restored to perfect health ; and remained in utter despair of ever being a widow.

From all this it will appear with what injustice this animal has hitherto been treated. It has undergone every reproach ; and mankind have been taught to consider as an enemy, a creature that destroys that insect tribe which are their real invaders. We are to treat, therefore, as fables, those accounts that present the toad as possessed of poison to kill at a distance ; of its ejecting its venom, which burns wherever it touches ; of its infecting those vegetables near which it resides ; of its excessive fondness for sage, which it renders poisonous by its approach : these, and a hundred others of the same kind, probably took rise from an antipathy which some have to all animals of the kind. It is a harmless, defenceless creature, torpid and unvenomous, and seeking the darkest retreats, not from the malignity of its nature, but the multitude of its enemies.

Like all of the frog kind, the toad is torpid in winter. It chooses then for a retreat either the hollow root of a tree, the

clest of a rock, or sometimes the bottom of a pond, where it is found in a state of seeming insensibility. As it is very long lived, it is very difficult to be killed; its skin is tough and cannot be easily pierced; and, though covered with wounds, the animal continues to show signs of life, and every part appears in motion. But what shall we say to its living for centuries lodged in the bosom of a rock, or cased in the body of an oak tree, without the smallest access on any side either for nourishment or air, and yet taken out alive and perfect! Stories of this kind it would be as rash to contradict, as difficult to believe; we have the highest authorities bearing witness to the truth, and yet the whole analogy of nature seems to arraign them of falsehood. Bacon asserts that toads are found in this manner; doctor Plot asserts the same; there is to this day a marble chimney-piece at Chatsworth with the print of the toad upon it, and a tradition of the manner in which it was found. In the memoirs of the academy of sciences, there is an account of a toad found alive and healthy in the heart of a very thick elm, without the smallest entrance or egress*. In the year 1731, there was another found near Nants in the heart of an old oak, without the smallest issue to its cell; and the discoverer was of opinion, from the size of the tree, that the animal could not have been confined there less than eighty or a hundred years, without sustenance and without air. To all these we can only oppose the strangeness of the facts; the necessity this animal appears under of receiving air; and its dying, like other animals, in the air-pump, when deprived of this all-sustaining fluid. But whether these be objections to weigh against such respectable and disinterested authority, I will not pretend to determine; certain it is, that if kept in a damp place, the toad will live for several months without any food whatsoever.

To this extraordinary account, which is doubtful, I will add another not less so; which is that of toads sucking cancerous breasts, and thus extracting the venom, and performing

* Vide the year 1719.

a cure. The first account we have of this is in a letter to the bishop of Carlisle from doctor Pitfield, who was the first person of consequence that attended the experiment. His letter is as follows :

“ Your lordship must have taken notice of a paragraph in the papers with regard to the application of toads to a cancered breast. A patient of mine has sent to the neighbourhood of Hungerford, and brought down the very woman on whom the cure was done. I have, with all the attention I am capable of, attended the operation for eighteen or twenty days, and am surprized at the phenomenon. I am in no expectation of any great service from the application ; the age, constitution, and thoroughly cancerous condition of the person, being unconquerable barriers to it. How an ailment of that kind, absolutely local, in an otherwise sound habit, and of a likely age, might be relieved, I cannot say. But as to the operation, thus much I can assert, that there is neither pain nor nauousefulness in it. The animal is put into a linen bag all but its head, and that is held to the part. It has generally instantly laid hold of the foulest part of the sore, and sucked with greediness until it dropped off dead. It has frequently happened that the creature has swollen immediately, and, from its agonies, appeared to be in great pain. I have weighed them for several days together, before and after application, and found their increase of weight, in their different degrees, from a drachm to near an ounce. They frequently sweat exceedingly, and turn quite pale ; sometimes they disgorge, recover, and become lively again : I think the whole scene is surprizing, and a very remarkable piece of natural history. From the constant inoffensiveness which I have observed in them, I almost question the truth of their poisonous spitting. Many people here expect no great good from the application of toads to cancers ; and where the disorder is not absolutely local, none is to be expected. When it is seated in any part not to be well come at for extirpation, I think it is hardly to be imagined, but that the having it sucked clean as often as you please, must give great relief. Every body knows that dogs licking of sores

cures them, which is, I suppose, chiefly by keeping them clean. If there is any credit to be given to history, poisons have been sucked out. *Pallentina vulnera lambit ore venena trahens*, are the words of Lucan on the occasion. If the people to whom these words are applied, did their cure by immediately following the injection of the poison, the local confinement of another poison brings the case to a great degree of similarity. I hope I have not tired your lordship with my long tail : as it is a true one, and in my apprehension, a curious piece of natural history, I could not forbear communicating it to you. I own I thought the story in the papers to be an invention ; and when I considered the instinctive principle in all animals of self-preservation, I was confirmed in my disbelief : but what I have related I saw ; and all theory must yield to fact. It is only the rubeth, the land toad, which has the property of sucking : I cannot find any the least mention of the property in any one of the old naturalists. My patient can bear to have but one applied in twenty-four hours. The woman, who was cured, had them on day and night, without intermission, for five weeks. Their time of hanging at the breast has been from one to six hours."

Other remarks made upon their method of performing this extraordinary operation are as follow. "Some toads die very soon after they have sucked ; others live about a quarter of an hour, and some much longer. For example, one that was applied about seven o'clock, sucked till ten, and died as soon as it was taken from the breast : another that immediately succeeded, continued till three o'clock, but dropped dead from the wound : each swelled exceedingly, and of a pale colour. They do not seem to suck greedily, and often turn their heads away ; but during the time of their sucking they were heard to smack their lips like a young child*."

From this circumstantial account of the progress of this extraordinary application, one could hardly suppose that any doubt could remain of the ingenious observer's accuracy ; and

yet, from information which I have received, from authority still more respectable, there is much reason as yet to suspend our assent. A lady, who was under the care of the present president of the college of physicians, was induced, by her friends, to try the experiment; and as he saw the case was desperate, and that it would quiet her mind as well as theirs, he permitted the trial. During the whole continuance of their application, she could never thoroughly perceive that they sucked her; but that did not prevent their swelling and dying, as in the former instances. Once, indeed, she said, she thought that one of them seemed to suck; but the physician, and those who attended, could not perceive any appearance of it. Thus, after all, it is a doubt whether these animals die by the internal or the external application of the cancerous poison.

Of this animal there are several varieties; such as the water and the land toad, which probably differ only in the ground colour of their skin. In the first, it is more inclining to ash-colour, with brown spots; in the other, the colour is brown, approaching to black. The water toad is not so large as the other; but both equally breed in that element. The size of the toad with us is generally from two to four inches long; but in the fenny countries of Europe, I have seen them much larger; and not less than a common crab, when brought to table. But this is nothing to what they are found in some of the tropical climates, where travellers often, for the first time, mistake a toad for a tortoise. Their usual size is from six to seven inches; but there are some still larger, and as broad as a plate. Of these, some are beautifully streaked and coloured; some studded over, as if with pearls; others bristled with horns or spines; some have the head distinct from the body, while others have it so sunk in, that the animal appears without a head. All these are found in the tropical climates, in great abundance; and particularly after a shower of rain. It is then that the streets seem entirely paved with them; they then crawl from their retreats, and go into all places, to enjoy their favourite moisture. With us, the opinion of its raining toads and frogs, has long been justly exploded, but it still is entertained

in the tropical countries ; and that not only by the savage natives, but the more refined settlers, who are apt enough to add the prejudices of other nations to their own.

It would be a tedious, as well as a useless task, to enter into all the minute discriminations of these animals, as found in different countries or places ; but the pipal, or Surinam toad, is too strange a creature, not to acquire an exact description. There is not, perhaps, in all nature, a more extraordinary phenomenon, than that of an animal breeding and hatching its young in its back ; from whence, as from a kind of hot-bed, they crawl, one after the other, when come to maturity.

The pipal is in form more hideous than even the common toad, nature seeming to have marked all those strange mannered animals with peculiar deformity. The body is flat and broad ; the head small ; the jaws, like those of a mole, are extended, and evidently formed for rooting in the ground : the skin of the neck forms a sort of wrinkled collar : the colour of the head is of a dark chestnut, and the eyes are small ; the back, which is very broad, is of a lightish grey, and seems covered over with a number of small eyes, which are round, and placed at nearly equal distances. These eyes are very different from what they seem ; they are the animal's eggs covered with their shells, and placed there for hatching. These eggs are buried deep in the skin, and in the beginning of incubation, but just appear ; and are very visible when the young animal is about to burst from its confinement. They are of a reddish, shining yellow colour ; and the spaces between them are full of small warts, resembling pearls.

This is their situation, previous to their coming forth ; but nothing so much demands our admiration, as the manner of their production. The eggs, when formed in the ovary, are sent, by some internal canals, which anatomists have not hitherto described, to lie and come to maturity under the bony substance of the back : in this state they are impregnated by the male, whose seed finds its way by pores very singularly contrived, and pierces not only the skin but the periosteum : the skin,

however, is still apparently entire, and forms a very thick covering over the whole brood ; but as they advance to maturity, at different intervals, one after another, the egg seems to start forward and burgeon from the back, becomes more yellow, and at last breaks ; when the young one puts forth its head : it still, however, keeps its situation, until it has acquired a proper degree of strength, and then it leaves the shell, but still continues to keep upon the back of the parent. In this manner the pipal is seen travelling with her wondrous family on her back, in all the different stages of maturity. Some of the strange progeny, not yet come to sufficient perfection, appear quite torpid, and as yet without life in the egg : others seem just beginning to rise through the skin ; here peeping forth from the shell ; and there, having entirely forsaken their prison : some are sporting at large upon the parent's back ; and others descending to the ground, to try their own fortune below.

Such is the description given us of this strange production, by Seba ; in which he differs from Ruysch, who affirms, that the young ones are bred in the back of the male only, where the female lays her eggs. I have followed Seba, however ; not because he is better authority, but because he is more positive of the truth of his account, and asserts, assuredly, that the eggs are found on the back of the female only. Many circumstances, however, are wanting towards completing his information ; such as a description of the passage by which the egg finds its way into the back ; the manner of its fecundation ; the time of gestation ; as also a history of the manners of this strange animal itself : but by a prolixity that too much prevails among naturalists at present, he leaves the most interesting object of curiosity, to give us a detailed description of the legs and claws of the pipal, about which we have very little concern.

The male pipal is every way larger than the female, and has the skin less tightly drawn round the body. The whole body is covered with pustules, resembling pearls ; and the

belly, which is of a bright yellow, seems as if it were sewed up from the throat to the vent, a seam being seen to run in that direction. This animal, like the rest of the frog kind, is most probably harmless ; though we are told of terrible effects resulting from its powder when calcined. This, however, must certainly be false : no creature whatever, when calcined, can be poisonous ; for the fire burns away whatever might have been dangerous in their composition : all animal substances, when calcined, being entirely the same.

C H A P. IV.

Of Lizards in General.

THERE is scarce a naturalist who has treated of lizards, but has a particular manner of ranking them, in the scale of animated nature. Ray, rather struck with the number of their legs than their habits and conformation, has exalted them among quadrupeds ; while Linnæus, attentive only to their long slender forms, has degraded them among serpents. Brisson gives them a distinct class by themselves, under the name of reptiles. Klein gives them a class inferior to beasts, under the name of naked quadrupeds. Some, in short, from their scaly covering, and fondness for the water, have given them to the fishes ; while there have not been wanting naturalists who have classed them with insects, as the smaller kinds of this class seem to demand.

It is indeed no easy matter to tell to what class in nature lizards are chiefly allied. They are unjustly raised to the rank of beasts, as they bring forth eggs, dispense with breathing, and are not covered with hair. They cannot be placed among fishes, as the majority of them live upon land : they are excluded from the serpent tribe, by their feet, upon which they run with some celerity ; and from the insects, by their size ;

for though the newt may be looked upon in this contemptible light, a crocodile would be a terrible insect indeed. Thus lizards are, in some measure, excluded from every rank ; while they exhibit somewhat of the properties of all ; the legs and celerity of the quadruped ; a facility of creeping through narrow and intricate ways, like the serpent ; and a power of living in the water, like fishes : however, though endued with these various powers, they have no real advantages over any other class of animated nature ; for what they gain in aptitude for one element, they lose in their fitness for another. Thus, between both, they are an awkward, ungainly tribe ; neither so alert upon land, nor so nimble in the water, as the respective inhabitants of either abode ; and, indeed, this holds through all nature, that, in proportion as the seeming advantages of inferior animals are multiplied, their real ones are abridged ; and all their instincts are weakened and lost, by the variety of channels into which they are divided.

As lizards thus differ from every other class of animals, they also differ widely from each other. With respect to size, no class of beings has its ranks so opposite. What, for instance, can be more removed than the small cameleon, an inch long, and the alligator of the river Amazons, above twenty-seven feet ! to an inattentive observer, they would appear entirely of different kinds ; and Seba wonders how they ever came to be classed together.

The colour of these animals also is very various, as they are found of a hundred different hues, green, blue, red, chestnut, yellow, spotted, streaked and marbled. Were colour alone capable of constituting beauty, the lizard would often please ; but there is something so repressing in the animal's figure, that the brilliancy of its scales, or the variety of its spots, only tend to give an air of more exquisite venom of greater malignity. The figure of these animals is not less various : sometimes swollen in the belly ; sometimes pursed up at the throat ; sometimes with a rough set of spines on the back, like the teeth of a saw ; sometimes with teeth, at others

with none ; sometimes venomous, at others harmless, and even philanthropic : sometimes smooth and even ; sometimes with a long slender tail ; and often with a shorter blunt one.

But their greatest distinction arises from their manner of bringing forth their young. Firstly, some of them are viviparous. Secondly, some are oviparous ; and which may be considered in three distinct ways. Thirdly, some bring forth small spawn, like fishes. The crocodile, the iguana, and all the larger kinds, bring forth eggs, which are hatched by the heat of the sun : the animals that issue from them are complete upon leaving the shell ; and their first efforts are to run to seek food in their proper element. The viviparous kinds, in which are all the salamanders, come forth alive from the body of the female, perfect and active, and suffer no succeeding change. But those which are bred in the water, and, as we have reason to think, from spawn, suffer a very considerable change in their form. They are produced with an external skin or covering, that sometimes encloses their feet, and gives them a serpentine appearance. To this false skin, fins are added, above and below the tail, that serve the animal for swimming ; but when the false skin drops off, these drop off also ; and then the lizard, with its four feet, is completely formed, and forsakes the water.

From hence it appears, that of this tribe there are three distinct kinds, differently produced, and most probably very different in their formation. But the history of these animals is very obscure ; and we are as yet incapable of laying the line that separates them. All we know, as was said before, is, that the great animals of this kind are *mostly* produced perfect from the egg ; the salamanders are *generally* viviparous ; and *some* of the water lizards imperfectly produced. In all these most unfinished productions of nature, if I may so call them, the varieties in their structure increases in proportion to their imperfections. A poet would say, that nature grew tired of the nauseous formation ; and left accident to finish the rest of her handy work.

However, the three kinds have many points of similitude; and, in all their varieties of figure, colour and production, this tribe is easily distinguished, and strongly marked. They have all four short legs; the two fore feet somewhat resembling a man's hand and arm. They have tails almost as thick as the body at the beginning, and that generally run tapering to a point. They are all amphibious also; equally capable of living upon land and water; and formed internally in the same manner with the tortoise and other animals, that can continue a long time without respiration: in other words, their lungs are not so necessary to continue life and circulation, but that their play may be stopped for some considerable time, while the blood performs its circuit round the body by a shorter communication.

These are differences that sufficiently separate lizards from all other animals; but it will be very difficult to fix the limits that distinguish the three kinds from each other. The *crocodile* tribe, and its affinities, are sufficiently distinguished from all the rest, by their size and fierceness; the *salamander* tribe is distinguished by their deformity, their frog-like heads, the shortness of their snouts, their swollen belly, and their viviparous production. With regard to the rest, which we may denominate the *cameleon* or lizard kind, some of which bring forth from the egg, and some of which are imperfectly formed from spawn, we must groupe them under one head, and leave time to unravel the rest of their history.

C H A P. V.

Of the Crocodile and its Affinities.

THE crocodile is an animal placed at a happy distance from the inhabitants of Europe; and formidable only in those regions where men are scarce, and arts are but little

known. In all the cultivated and populous parts of the world, the great animals are entirely banished, or rarely seen. The appearance of such raises at once a whole country up in arms to oppose their force ; and their lives generally pay the forfeit of their temerity. The crocodile, therefore, that was once so terrible along the banks of the river Nile, is now neither so large, nor its numbers so great as formerly. The arts of mankind have, through a course of ages, powerfully operated to its destruction ; and, though it is sometimes seen, it appears comparatively timorous and feeble.

To look for this animal in all its natural terrors, grown to an enormous size, propagated in surprizing numbers, and committing unceasing devastations, we must go to the uninhabited regions of Africa and America, to those immense rivers that roll through extensive and desolate kingdom, where arts have never penetrated, where force only makes distinction, and the most powerful animals exert their strength with confidence and security. Those that sail up the river Amazons, or the river Niger, well know how numerous and terrible those animals are in such parts of the world. In both these rivers, they are found from eighteen to twenty-seven feet long ; and sometimes lying as close to each other, as a raft of timber upon one of our streams. There they indolently bask on the surface, no way disturbed at the approach of an enemy, since, from the repeated trials of their strength, they found none that they were not able to subdue.

Of this terrible animal there are two kinds ; the crocodile, properly so called, and the cayman or alligator. Travellers, however, have rather made the distinction than nature ; for in the general outline, and in the nature of these two animals, they are entirely the same. It would be speaking more properly to call these animals the crocodiles of the eastern and the western world ; for, in books of voyages, they are so entirely confounded together, that there is no knowing whether the Asiatic animal be the crocodile of Asia, or the alligator of the western world. The distinctions usually made between the croco-

dile and alligator are these : the body of the crocodile is more slender than that of the alligator ; its snout runs off tapering from the forehead, like that of a grey-hound ; while that of the other is indented, like the nose of a lap-dog. The crocodile has a much wider swallow, and is of an ash-colour ; the alligator is black, varied with white, and is thought not to be so mischievous. All these distinctions, however, are very slight, and can be reckoned little more than minute variations.

This animal grows to a great length, being sometimes found thirty feet long, from the tip of the snout to the end of the tail : its most usual length, however, is eighteen. One, which was dissected by the Jesuits at Siam, was of the latter dimensions ; and, as the description which is given of it, both externally and internally, is the most accurate known of this noted animal, I must beg leave to give it as I find it, though somewhat tedious. It was eighteen feet and a half, French measure, in length ; of which the tail was no less than five feet and a half, and the head and neck above two feet and a half. It was four feet nine inches in circumference, where thickest. The fore legs had the same parts and conformation as the arms of a man, both within and without. The hands, if they may be so called, had five fingers ; the two last of which had no nails, and were of a conical figure. The hinder legs, including the thigh and paw, were two feet two inches long ; the paws, from the joint to the extremity of the longest claws, were above nine inches : they were divided into four toes, of which three were armed with large claws, the longest of which was an inch and a half : these toes were united by a membrane, like those of a duck, but much thicker. The head was long, and had a little rising at the top ; but the rest was flat, and especially towards the extremity of the jaws. It was covered by a skin, which adhered firmly to the skull and to the jaws. The skull was rough and unequal in several places ; and about the middle of the forehead there were two bony crests, about two inches high ; the skull between these two crests was proof against a musquet-ball ; for it only rendered the part a little

white that it struck against. The eye was very small, in proportion to the rest of the body, and was so placed within its orbit, that the outward part, when the lid was closed, was only an inch long, and the line running parallel to the opening of the jaws. It was covered with a double lid, one within and one without : that within, like the nictitating membrane in birds, was folded in the great corner of the eye, and had a motion towards the tail, but being transparent, it covered the eye without hindering the sight. The iris was very large in proportion to the globe of the eye, and was of a yellowish grey colour. Above the eye, the ear was placed, which opened from above downwards, as if it were by a kind of spring, by means of a solid, thick, cartilaginous substance. The nose was placed in the middle of the upper jaw, near an inch from its extremity, and was perfectly round and flat, being near two inches in diameter, of a black, soft, spongy substance, not unlike the nose of a dog. The jaws seemed to shut one within another ; and nothing can be more false than that the animal's under jaw is without motion ; it moves, like the lower jaw in all other animals, while the upper is fixed to the skull, and absolutely immovable. The animal had twenty-seven cutting teeth in the upper jaw, and fifteen in the lower, with several void spaces between them : they were thick at the bottom, and sharp at the point, being all of different sizes, except ten large hooked ones, six of which were in the lower jaw, and four in the upper. The mouth was fifteen inches in length, and eight and a half in breadth, where broadest. The distance of the two jaws, when opened as wide as they could be, was fifteen inches and a half : this is a very wide yawn, and could easily enough take in the body of a man. The colour of the body was of a dark brown on the upper part, and of a whitish citron below, with large spots of both colours on the sides. From the shoulders to the extremity of the tail, the animal was covered with large scales of a square form, disposed like parallel girdles, and fifty-two in number ; but those near the tail were not so thick as the rest. The creature was covered not only with these, but all over with a coat of armour ; which, however, was not

proof against a musquet ball, contrary to what has been commonly asserted : however, it must be confessed, that the attitude in which the animal was placed, might contribute to render the skin more penetrable ; for probably if the ball had struck obliquely against the shell it would have flown off. Those parts of the girdles underneath the belly were of a whitish colour, and were made of scales of divers shapes, but not so hard as those on the back.

With respect to the internal parts of the animal, the gullet was large in proportion to the mouth ; and a ball of wood as large as one's head, readily ran down, and was drawn up again. The guts were but short, in comparison, being not so long as the animal's body. The tongue, which some have erroneously asserted this animal was without, consisted of a thick spongy soft flesh, and was strongly connected to the lower jaw. The heart was of the size of a calf's, of a bright red colour, the blood passing as well from the veins to the aorta as into the lungs. There was no bladder ; but the kidneys sent the urine to be discharged by the anus. There were sixty-two joints in the back-bone, which, though very closely united, had sufficient play to enable the animal to bend like a bow to the right and the left ; so that what we hear of escaping the creature by turning out of the right line, and of the animal's not being able to wheel readily after its prey, seems to be fabulous. It is most likely the crocodile can turn with great ease, for the joints of its back are not stiffer than those of other animals, which we know by experience can wheel about very nimbly for their size.

Such is the figure and conformation of this formidable animal, that unpeoples countries, and makes the most navigable rivers desert and dangerous. They are seen, in some places, lying for whole hours, and even days, stretched in the sun, and motionless ; so that one not used to them, might mistake them for trunks of trees, covered with a rough and dry bark ; but the mistake would soon be fatal, if not prevented : for the torpid animal, at the near approach of any living thing, darts upon it with instant swiftness, and at once drags it down to the bot-

tom. In the times of an inundation, they sometimes enter the cottages of the natives, where the dreadful visitant seizes the first animal it meets with. There have been several examples of their taking a man out of a canoe in the sight of his companions, without their being able to lend him any assistance.

The strength of every part of the crocodile is very great; and its arms, both offensive and defensive, irresistible. We have seen, from the shortness of its legs, the amazing strength of the tortoise; but what is the strength of such an animal, compared to that of the crocodile, whose legs are very short, and whose size is so superior. The back-bone is jointed in the firmest manner; the muscles of the fore and hinder legs are vigorous and strong; and its whole form calculated for force. Its teeth are sharp, numerous and formidable; its claws are long and tenacious; but its principal instrument of destruction is the tail; with a single blow of this, it has often overturned a canoe, and seized upon the poor savage its conductor.

Though not so powerful, yet it is very terrible even upon land. The crocodile seldom, except when pressed by hunger, or with a view of depositing its eggs, leaves the water. Its usual method is to float along upon the surface, and seize whatever animals come within its reach; but when this method fails, it then goes closer to the bank. Disappointed of its fishy prey, it there waits covered up among the sedges, in patient expectation of some land animal that comes to drink; the dog, the bull, the tiger, or man himself. Nothing is to be seen of the insidious destroyer as the animal approaches; nor is its retreat discovered till it be too late for safety. It seizes the victim with a spring, and goes at a bound much faster than so unwieldy an animal could be thought capable of exerting; then having secured the creature with both teeth and claws, it drags it into the water, instantly sinks with it to the bottom, and in this manner quickly drowns it.

Sometimes it happens, that the creature, the crocodile has thus surprized, escapes from its grasp wounded, and makes off

from the river side. In such a case, the tyrant pursues with all its force, and often seizes it a second time; for though seemingly heavy, the crocodile runs with great celerity. In this manner it is sometimes seen above half a mile from the bank, in pursuit of an animal wounded beyond the power of escaping, and then dragging it back to the river-side, where it feasts in security.

It often happens, in its depredations along the bank, that the crocodile seizes on a creature as formidable as itself, and meets with a most desperate resistance. We are told of frequent combats, between the crocodile and the tiger. All creatures of the tiger kind, are continually oppressed by a parching thirst, that keeps them in the vicinity of great rivers, whither they descend to drink very frequently. It is upon these occasions, that they are seized by the crocodile; and they die not unrevenged. The instant they are seized upon, they turn with the greatest agility, and force their claws into the crocodile's eyes, while he plunges with his fierce antagonist into the river. There they continue to struggle for some time, till at last the tiger is drowned.

In this manner, the crocodile seizes and destroys all animals, and is equally dreaded by all. There is no animal, but man alone, that can combat it with success. We are assured, by Labat, that a negro, with no other weapons than a knife in his right hand, and his left arm wrapped round with a cow hide, ventures boldly to attack this animal, in its own element. As soon as he approaches the crocodile, he presents his left arm, which the animal swallows most greedily; but sticking in its throat, the negro has time to give it several stabs under the throat; and the water, also, getting in it at the mouth, which is held involuntarily open, the creature is soon bloated up as big as a tun, and expires.

To us, who live at a distance from the rapacity of these animals, these stories appear strange, and yet most probably are true. From not having seen any thing so formidable, or bold in the circle of our own experience, we are not to determine

upon the wonderful transactions in distant climates. It is probable that these, and a number of more dreadful encounters, happen every day, among those forests, and in those rivers where the most formidable animals are known to reside; where the elephant and the rhinoceros, the tiger and the hippopotamos, the shark and the crocodile, have frequent opportunities of meeting, and every day of renewing their engagements.

Whatever be the truth of these accounts, certain it is, that crocodiles are taken by the Siamese in great abundance. The natives of that empire seem particularly fond of the capture of all the great animals, with which their country abounds. We have already seen their success in taking and taming the elephant; nor are they less powerful in exerting their dominion over the crocodile. The manner of taking it in Siam, is by throwing three or four strong nets across a river, at proper distances from each other; so that if the animal breaks through the first, it may be caught by one of the rest. When it is first taken, it employs the tail, which is the grand instrument of strength, with great force; but after many unsuccessful struggles, the animal's strength is at last exhausted. Then the natives approach their prisoner in boats, and pierce him with their weapons, in the most tender parts, till he is weakened with the loss of blood. When he has done stirring, they begin by tying up his mouth, and, with the same cord, they fasten his head to his tail, which last they bend back like a bow. However, they are not yet perfectly secure from his fury; but, for their greater safety, they tie his fore feet as well as those behind, to the top of his back. These precautions are not useless; for, if they were to omit them, the crocodile would soon recover strength enough to do a great deal of mischief.

The crocodile, thus brought into subjection, or bred up young, is used to divert and entertain the great men of the east. It is often managed like a horse; a curb is put into its mouth, and the rider directs it as he thinks proper. Though awkwardly formed, it does not fail to proceed with some degree of

swiftness; and is thought to move as fast as some of the most unwieldy of our own animals, the hog or the cow. Some, indeed, assert that no animal could escape it, but for its difficulty in turning; but, to this resource, we could wish none would trust, who are so unhappy as to find themselves in danger.

Along the rivers of Africa, this animal is sometimes taken in the same manner as the shark. Several Europeans go together in a large boat, and throw out a piece of beef upon a hook and strong fortified line, which the crocodile seizing and swallowing, is drawn along, floundering and struggling until its strength is quite exhausted; when it is pierced in the belly, which is its tenderest part; and thus, after numberless wounds, is drawn on shore. In this part of the world also, as well as at Siam, the crocodile makes an object of savage pomp near the palaces of their monarchs. Philips informs us that at Sabi, on the slave coasts, there are two pools of water near the royal palace, where crocodiles are bred as we breed carp in our ponds in Europe.

Hitherto I have been describing the crocodile as it is found in unpeopled countries, and undisturbed by frequent encounters with mankind. In this state it is fierce and cruel, attacking every object that seems endued with motion: but in Egypt, and other countries long peopled, where the inhabitants are civilized and the rivers frequented, this animal is solitary and fearful. So far from coming to attack a man, it sinks at his approach with the utmost precipitation; and, as if sensible of superior power, ever declines the engagement. We have seen more than one instance in animated nature of the contempt which at first the lower orders of the creation have for man, till they have experienced his powers of destruction. The lion and the tiger among beasts, the whale among fishes, the albatross and the penguin among birds, meet the first encounters of man without dread or apprehension; but they soon learn to acknowledge his superiority; and take refuge from his power in the deepest fastnesses of nature. This may account for the different characters which have been given us

of the crocodile and the alligator by travellers at different times : some describing them as harmless and fearful, as ever avoiding the sight of a man, and preying only upon fishes ; others ranking them among the destroyers of nature ; describing them as furnished with strength and impelled by malignity to do mischief ; representing them as the greatest enemies of mankind, and particularly desirous of human prey. The truth is, the animal has been justly described by both ; being such as it is found in places differently peopled or differently civilized. Wherever the crocodile has reigned long unmolested, it is there fierce, bold and dangerous ; wherever it has been harrassed by mankind, its retreats invaded, and its numbers destroyed, it is there timorous and inoffensive.

In some places, therefore, this animal, instead of being formidable, is not only inoffensive, but is cherished and admired. In the river San Domingo, the crocodiles are the most inoffensive animals in nature ; the children play with them, and ride about on their backs ; they even beat them sometimes without receiving the smallest injury. It is true the inhabitants are very careful of this gentle breed, and consider them as harmless domestics.

It is probable that the smell of musk, which all these animals exhale, may render them agreeable to the savages of that part of Africa. They are often known to take the part of this animal which contains the musk, and wear it as a perfume about their persons. Travellers are not agreed in what part of the body these musk-bags are contained ; some say in the ears ; some in the parts of generation ; but the most probable opinion is, that this musky substance is amassed in glands under the legs and arms. From whatsoever part of the body this odour proceeds, it is very strong and powerful, tincturing the flesh of the whole body with its taste and smell. The crocodile's flesh is at best very bad tough eating ; but, unless the musk-bags be separated, it is insupportable. The negroes themselves cannot well digest the flesh ; but then, a crocodile's egg is to them the most delicate morsel in the world. Even sava-

ges exhibit their epicures as well as we ; and one of true taste will spare neither pains nor danger to furnish himself with his favourite repast. For this reason, he often watches the places where the female comes to lay her eggs, and, upon her retiring, seizes the booty.

All crocodiles breed near fresh waters ; and though they are sometimes found in the sea, yet that may be considered rather as a place of excursion than abode. They produce their young by eggs, as was said above ; and for this purpose, the female, when she comes to lay, chooses a place by the side of a river, or some fresh-water lake, to deposit her brood in. She always pitches up an extensive sandy shore, where she may dig a hole without danger of detection from the ground being fresh turned up. The shore must also be gentle and shelving to the water, for the greater convenience of the animal's going and returning ; and a convenient place must be found near the edge of the stream, that the young may have a shorter way to go. When all these requisites are adjusted, the animal is seen cautiously stealing up on shore to deposit her burthen. The presence of a man, a beast, or even a bird, is sufficient to deter her at that time ; and if she perceives any creature looking on, she infallibly returns. If, however, nothing appears, she then goes to work, scratching up the sand with her fore paws, and making a hole pretty deep in the shore. There she deposits from eighty to a hundred eggs, of the size of a tennis-ball, and of the same figure, covered with a tough white skin like parchment. She takes above an hour to perform this task ; and then covering up the place so artfully, that it can scarcely be perceived, she goes back to return again the next day. Upon her return, with the same precaution as before, she lays about the same number of eggs, and the day following also a like number. Thus having deposited her whole quantity, and having covered them close up in the sand, they are soon vivified by the heat of the sun ; and at the end of thirty days, the young ones begin to break open the shell. At this time the female is instinctively taught that her young ones want relief ; and she goes up on land to scratch away the sand and

set them free. Her brood quickly avail themselves of their liberty; a part run unguided to the water; another part ascend the back of the female, and are carried thither in greater safety. But the moment they arrive at the water, all natural connection is at an end: when the female has introduced her young to their natural element, not only she, but the male, become among the number of their most formidable enemies, and devour as many of them as they can. The whole brood scatters into different parts at the bottom; by far the greatest number are destroyed; and the rest find safety in their agility or minuteness.

But it is not the crocodile alone that is thus found to thin their numbers; the eggs of this animal are not only a delicious feast to the savage, but are eagerly sought after by every beast and bird of prey. The ichneumon was erected into a deity among the ancients for its success in destroying the eggs of these monsters: at present, that species of the vulture, called the gallinazo, is their most prevailing enemy. All along the banks of great rivers, for thousands of miles, the crocodile is seen to propagate in numbers that would soon over-run the earth, but for the vulture, that seems appointed by providence to abridge its fecundity. These birds are ever found in greatest abundance where the crocodile is most numerous; and hiding themselves within the thick branches of the trees that shade the banks of the river, they watch the female in silence, and permit her to lay all her eggs without interruption. Then when she has retired, they encourage each other with cries to the spoil; and flocking all together upon the hidden treasure, tear up the eggs, and devour them in a much quicker time than they were deposited. Nor are they less diligent in attending the female while she is carrying her young to the water; for if any one of them happens to drop by the way, it is sure to receive no mercy.

Such is the extraordinary account given us by late travellers of the propagation of this animal; an account adopted by

Linnaeus and the most learned naturalists of the age*. Yet, if one might argue from the general analogy of nature, the crocodile's devouring her own young, when she gets to the water, seems doubtful. This may be a story raised from the general idea of this animal's rapacious cruelty; when, in fact, the crocodile only seems more cruel than other animals, because it has more power to do mischief. It is probable that it is not more divested of parental tenderness than other creatures; and I am the more led to think so from the peculiar formation of one of the crocodile kind. This is called the open-bellied crocodile, and is furnished with a false belly like the opossum, where the young creep out and in, as their dangers or necessities require. The crocodile thus furnished, at least cannot be said to be an enemy to her own young, since she thus gives them more than parental protection. It is probable; also, that this open-bellied crocodile is viviparous, and fosters her young that are prematurely excluded in this second womb, until they come to proper maturity.

How long the crocodile lives we are not certainly informed; if we may believe Aristotle, it lives the age of a man; but the ancients so much amused themselves in inventing fables concerning this animal, that even truth from them is suspicious. What we know for certain from the ancients is, that among the various animals that were produced to fight in the amphitheatre at Rome, the combat of the crocodile was not wanting†. Marcus Scaurus produced them living in his unrivalled exhibitions; and the Romans considered him as the best citizen, because he furnished them with the most expensive entertainments. But entertainment, at that corrupt time, was their only occupation.

* Ulloa.

† Plin. lib. viii. c. 26.

C H A P. VI.

Of the Salamander.

THE ancients have described a lizard that is bred from heat, that lives in the flames, and feeds upon fire as its proper nourishment. As they saw every other element, the air, the earth or water, inhabited, fancy was set to work to find or make an inhabitant in fire; and thus to people every part of nature. It will be needless to say that there is no such animal existing; and that, of all others, the modern salamander has the smallest affinity to such an abode.

Whether the animal that now goes by the name of the salamander, be the same with that described by Pliny, is a doubt with me; but this is not a place for the discussion. It is sufficient to observe, that the modern salamander is an animal of the lizard kind, and under this name is comprehended a large tribe that all go by the same name. There have been not less than seven sorts of this animal described by Seba; and to have some idea of the peculiarity of their figure, if we suppose the tail of a lizard applied to the body of a frog, we shall not be far from precision. The common lizard is long, small and taper; the salamander, like the frog, has its eyes towards the back of the head; like the frog, its snout is round and not pointed, and its belly thick and swollen. The claws of its toes are short and feeble; its skin rough; and the tongue, unlike that of the smallest of the lizard kind, in which it is long and forked, is short, and adhering to the under jaw.

But it is not in figure that this animal chiefly differs from the rest of the lizard tribe; for it seems to differ in nature and conformation. In nature, it is unlike, being an heavy, torpid animal; whereas the lizard tribe are active, restless, and

ever in motion : in conformation it is unlike, as the salamander is produced alive from the body of its parent, and is completely formed the moment of its exclusion. It differs from them also in its general reputation of being venomous ; however, no trials that have been hitherto made, seem to confirm the truth of the report.

Not only this, but many others of the lizard tribe are said to have venom ; but it were to be wished that mankind, for their own happiness, would examine into the foundation of this reproach. By that means many of them, that are now shunned and detested, might be found inoffensive ; their figure, instead of exciting either horror or disgust, would then only tend to animate the general scene of nature ; and speculation might examine their manners in confidence and security. Certain it is, that all of the lizard kind with which we are acquainted in this country, are perfectly harmless ; and it is equally true, that, for a long time, till our prejudices were removed, we considered not only the newt, but the snake and the blind-worm, as fraught with the most destructive poison. At present we have got over these prejudices ; and, it is probable, that, if other nations made the same efforts for information, it would be found, that the malignity of most, if not all, of the lizard tribe, was only in the imagination.

With respect to the salamander, the whole tribe, from the moron to the gekko, are said to be venomous to the last degree ; yet, when experiments have been tried, no arts, no provocations, could excite these animals to the rage of biting. They seem timid and inoffensive, only living upon worms and insects ; quite destitute of fangs, like the viper ; their teeth are so very small, that they are hardly able to inflict a wound. But as the teeth are thus incapable of offending, the people of the countries where they are found have recourse to a venomous flaver, which, they suppose, issues from the animal's mouth ; they also tell us of a venom issuing from the claws : even Linnæus seems to acknowledge the fact ; but

thinks it a probable supposition that this venom may proceed from their urine.

Of all animals, the gekko is the most notorious for its powers of mischief: yet, we are told by those who load it with that calumny, that it is very friendly to man, and though supplied with the most deadly virulence, is yet never known to bite. It would be absurd in us, without experience, to pronounce upon the noxious or inoffensive qualities of animals: yet it is most probable, from an inspection of the teeth of lizards, and from their inoffensive qualities in Europe, that the gekko has been unjustly accused; and that its serpent-like figure has involved it in one common reproach with serpents.

The salamander best known in Europe, is from eight to eleven inches long, usually black, spotted with yellow; and when taken in the hand, feeling cold to a great degree. There are several kinds. Our black water newt is reckoned among the number. The idle report of its being incombustible in fire, has caused many of these poor animals to be burnt; but we cannot say as philosophical martyrs; since scarce any philosopher could think it necessary to make the experiment. When thrown into the fire, the animal is seen to burst with the heat of its situation, and to eject its fluids. We are gravely told, in the philosophical transactions, that this is a method the animal takes to extinguish the flames.

When examined internally, the salamander exhibits little difference from other animals of the lizard kind. It is furnished with lungs that sometimes serve for the offices of breathing; with a heart that has its communications open, so that the animal cannot easily be drowned. The ovary in the female is double the size of what it is in others of this tribe; and the male is furnished with four testiculi instead of two. But what deserves particular notice is the manner of this animal's bringing forth its young alive*. "The salamander," says my

* Acta Hafnienſia. ann. 1676. Obſerv. 11. Memeires de l'Academie Royale de Sciences. tom. iii. part 3, p. 80.

author, "begins to show itself in spring, and chiefly during heavy rains. When the warm weather returns it disappears; and never leaves its hole, during either great heats or severe colds, both which it equally fears. When taken in the hand, it appears like a lump of ice; it consequently loves the shade, and is found at the feet of old trees surrounded with brush-wood at the bottom. It is fond of running along new-plowed grounds; probably to seek for worms, which are its ordinary food. One of these," continues my author, "I took alive some years ago in a ditch that had been lately made. I laid it at the foot of the stairs upon coming home, and there it disgorged from the throat a *worm* three inches long, that lived for an hour after, though wounded, as I suppose, by the teeth of the animal. I afterwards cut up another of these lizards, and saw not less than fifty young ones, resembling the parent, come from its womb, all alive, and actively running about the room." It were to be wished the author had used another word beside that of *worm*; as we now are in doubt whether he means a real worm, or a young animal of the lizard species: had he been more explicit, and had it appeared that it was a real young lizard, which I take to be his meaning, we might here see a wonder of nature, brought to the proof which many have asserted, and many have thought proper to deny:—I mean the refuge which the young of the shark, the lizard, and the viper kinds, are said to take, by running down the throat of the parent, and there finding a temporary security. The fact, indeed, seems a little extraordinary; and yet it is so frequently attested by some, and even believed by others, whose authority is respectable, among the number of whom we find Mr. Penant, that the argument of strangeness must give way to the weight of authority.

However this be, there is no doubt of the animal's being viviparous, and producing above fifty at a time. They come from the parent in full perfection, and quickly leave her to shift for themselves. These animals, in the lower ranks of nature, want scarce any help when excluded; they soon complete the little circle of their education; and in a day or two

are capable of practising all the arts of subsistence and evasion practised by their kind.

They are all amphibious, or at least are found capable of subsisting in either element, when placed there : if those taken from land are put into water, they continue there in seeming health ; and, on the contrary, those taken from the water will live upon land. In water, however, they exhibit a greater variety in their appearance ; and what is equally wonderful with the rest of their history, during the whole spring and summer, this water lizard changes its skin every fourth or fifth day ; and during the winter every fifteen days. This operation they perform by means of the mouth and the claws ; and it seems a work of no small difficulty and pain. The cast skins are frequently seen floating on the surface of the water : they are sometimes seen also with a part of their old skin still sticking to one of their limbs, which they have not been able to get rid of ; and thus, like a man with a boot half drawn, in some measure crippled in their own spoils. This also often corrupts, and the leg drops off ; but the animal does not seem to feel the want of it, for the loss of a limb to all the lizard kind is but a trifling calamity. They can live several hours even after the loss of their head : and for some time under dissection, all the parts of this animal seem to retain life : but the tail is the part that longest retains its motion. Salt seems to be much more efficacious in destroying these animals, than the knife ; for, upon being sprinkled with it, the whole body emits a viscid liquor, and the lizard dies in three minutes, in great agonies.

The whole of the lizard kind are also tenacious of life in another respect, and the salamander among the number. They sustain the want of food in a surprising manner. One of them, brought from the Indies, lived nine months, without any other food than what it received from licking a piece of earth on which it was brought over* : another was kept by Seba in an empty vial for six months, without any nou-

* Phil. Transf. ann. 1661. N. 21. art. 7.

rishment ; and Redi talks of a large one, brought from Africa, that lived for eight months, without taking any nourishment whatever. Indeed, as many of this kind, both salamanders and lizards, are torpid, or nearly so, during the winter, the loss of their appetite for so long a time is the less surprizing.

C H A P. VII.

Of the Cameleon, the Iguana, and Lizards of different Kinds.

IT were to be wished that animals could be so classed, that by the very mentioning their rank, we should receive some insight into their history. This I have endeavoured in most instances ; but in the present chapter all method is totally unserviceable. Here distribution gives no general ideas: for some of the animals to be here mentioned produce by eggs ; some by spawn ; and some are viviparous. The peculiar manner of propagating in each, is very indistinctly known. The iguana and the cameleon, we know bring forth eggs ; some others also produce in the same manner : but of the rest, which naturalists make amount to above fifty, we have but very indistinct information.

In the former divisions of this tribe, we had to observe upon animals, formidable from their size, or disgusting from their frog-like head and appearance ; in the present division, all the animals are either beautiful to the eye, or grateful to the appetite. The lizards, properly so called, are beautifully painted and mottled ; their frolicsome agility is amusing to those who are familiar with their appearance ; and the great affection which some of them show to man, should, in some measure, be repaid with kindness. Others, such as the iguana, though not possessed of beauty, are very serviceable, furnishing one of the most luxurious feasts the tropical climates can boast of. Those treated of before were objects of curiosity,

because they were apparently objects of danger: most of these here mentioned have either use or beauty to engage us.

Directly descending from the crocodile, we find the cordyle, the tockay, and the tejuguaca, all growing less in order, as I have named them. These fill up the chasm to be found between the crocodile and the African iguana.

The iguana, which deserves our notice, is about five feet long, and the body about as thick as one's thigh: the skin is covered with small scales, like those of a serpent; and the back is furnished with a row of prickles, that stand up, like the teeth of a saw: the eyes seem to be but half opened, except when the animal is angry, and then they appear large and sparkling: both the jaws are full of very sharp teeth, and the bite is dangerous, though not venomous, for it never lets loose till it is killed. The male has a skin hanging under his throat, which reaches down to his breast; and, when displeased, he puffs it up like a bladder: he is one third larger and stronger than the female, though the strength of either avails them little towards their defence. The males are ash-coloured, and the females are green.

The flesh of these may be considered as the greatest delicacy of Africa and America; and the sportsmen of those climates go out to hunt the iguana, as we do in pursuit of the pheasant or the hare. In the beginning of the season, when the great floods of the tropical climates are passed away, and vegetation starts into universal verdure, the sportsmen are seen, with a noose and a stick, wandering along the sides of the rivers, to take the iguana. This animal, though apparently formed for combat, is the most harmless creature of all the forest; it lives among trees, or sports in the water, without ever offering to offend: there, having fed upon the flowers of the mahot, and the leaves of the mapou, that grow along the banks of the stream, it goes to repose upon the branches of the trees that hang over the water. Upon land the animal is swift of foot; but when once in possession of a tree, it seems conscious of the security of its situation, and never offers to stir. There the

sportsman easily finds it, and as easily fastens his noose round its neck: if the head be placed in such a manner that the noose cannot readily be fastened, by hitting the animal a blow on the nose with the stick, it lifts the head, and offers it in some measure to the noose. In this manner, and also by the tail, the iguana is dragged from the trees, and killed by repeated blows on the head.

The cameleon is a very different animal; and as the iguana satisfies the appetites of the epicure, this is rather the feast of the philosopher. Like the crocodile, this little animal proceeds from an egg; and it also nearly resembles that formidable creature in form: but it differs widely in its size and its appetites; being not above eleven inches long, and delighting to sit upon trees, being afraid of serpents, from which it is unable to escape on the ground.

The head of a large cameleon is almost two inches long; and from thence to the beginning of the tail, four and a half: the tail is five inches long, and the feet two and a half: the thickness of the body is different at different times; for sometimes, from the back to the belly, it is two inches, and sometimes but one; for it can blow itself up, and contract itself, at pleasure. This swelling and contraction is not only of the back and belly, but of the legs and tail.

These different tumours do not proceed from the dilatation of the breast in breathing, which rises and falls by turns; but are very irregular, and seem adopted merely from caprice. The cameleon is often seen, as it were, blown up for two hours together; and then it continues growing less and less insensibly; for the dilatation is always more quick and visible than the contraction. In this last state the animal appears extremely lean; the spine of the back seems sharp, and all the ribs may be counted; likewise the tendons of the legs and arms may be seen very distinctly.

This method of puffing itself up, is similar to that in pigeons, whose crops are sometimes greatly distended with air.

The camelion has a power of driving the air it breathes, over every part of the body : however, it only gets between the skin and the muscles ; for the muscles themselves are never swollen. The skin is very cold to the touch ; and though the animal seems so lean, there is no feeling the beating of the heart. The surface of the skin is unequal, and has a grain not unlike shagreen, but very soft, because each eminence is as smooth as if it were polished. Some of these little protuberances are as large as a pin's head, on the arms, legs, belly and tail ; but on the shoulders and head they are of an oval figure, and a little larger : those under the throat are ranged in the form of a chaplet, from the lower lip to the breast. The colour of all these eminences, when the camelion is at rest in a shady place, is of a bluish grey, and the space between is of a pale red and yellow.

But when the animal is removed into the sun, then comes the wonderful part of its history. At first it appears to suffer no change of colour, its greyish spots still continuing the same : but the whole surface soon seems to imbibe the rays of light ; and the simple colouring of the body changes into a variety of beautiful hues. Wherever the light comes upon the body, it is of a tawny brown ; but that part of the skin on which the sun does not shine, changes into several brighter colours, pale yellow, or vivid crimson ; which form spots of the size of half one's finger : some of these descend from the spine half way down the back ; and others appear on the sides, arms and tail. When the sun has done shining, the original grey colour returns by degrees, and covers all the body. Sometimes the animal become all over spotted with brown spots, of a greenish cast. When it is wrapped up in a white linen cloth for two or three minutes, the natural colour becomes much lighter ; but not quite white, as some authors have pretended : however, from hence it must not be concluded, that the camelion assumes the colour of the objects which it approaches ; this is entirely an error, and probably has taken its rise from the continual changes it appears to undergo.

Le Bruyn, in his voyage to the Levant, has given us a very ample description of the cameleon. During his stay at Smyrna, he bought several of this kind, and, to try how long they could live, kept four of them in a cage, permitting them at times to run about the house. The fresh sea-breeze seemed to give them most spirits and vivacity; they opened their mouths to take it in: he never perceived that they ate any thing, except now and then a fly, which they took half an hour to swallow: he observed their colour often to change, three or four times successively, without being able to find out any cause for such alterations: their common colour he found to be grey, or rather a pale mouse colour; but its most frequent changes were into a beautiful green, spotted with yellow: sometimes the animal was marked all over with dark brown; and this often changed into a lighter brown; some colours, however, it never assumed; and, contrary to what was said above, he found red to be among the number.

Though our traveller took the utmost care, he was unable to preserve any of them alive above five months; and many of them died in four. When the cameleon changes place, and attempts to descend from an eminence, it moves with the utmost precaution, advancing one leg very deliberately before the other, still securing itself by holding whatever it can grasp by the tail. It seldom opens the mouth, except for fresh air; and, when that is supplied, discovers its satisfaction by its motions, and the frequent changes of its colour. The tongue is sometimes darted out after its prey, which is flies; and this is as long as the whole body. The eyes are remarkably little, though they stand out of the head: they have a single eye-lid, like a cap with a hole in the middle, through which the sight of the eye appears, which is of a shining brown; and round it there is a little circle of a gold colour: but the most extraordinary part of their conformation is, that the animal often moves one eye, when the other is entirely at rest; nay, sometimes one eye will seem to look directly forward, while the other looks backward; and one will look upwards, while the other regards the earth.

To this class of lizards, we may refer the dragon, a most terrible animal, but most probably not of nature's formation. Of this death-dealing creature all people have read; and the most barbarous countries, to this day, paint it to the imagination in all its terrors, and fear to meet it in every forest. It is not enough that nature has furnished those countries with poisons of various malignity; with serpents forty feet long; with elephants, lions and tigers, to make their situation really dangerous; the capricious imagination is set at work to call up new terrors; and scarce a savage is found, that does not talk of winged serpents of immoderate length, flying away with the camel or the rhinoceros, or destroying mankind by a single glare. Happily, however, such ravagers are no where found to exist at present; and the whole race of dragons is dwindled down to the flying lizard, a little harmless creature, that only preys upon insects and even seems to embellish the forest with its beauty.

The flying lizard of Java perches upon fruit-trees, and feeds upon flies, ants, butterflies, and other small insects. It is a very harmless creature, and does no mischief in any respect. Gentil, in his voyage round the world, affirms, that he has seen these lizards at the island of Java, in the East-Indies. He observed they flew very swiftly from tree to tree; and having killed one, he could not but admire the skin, which was painted with several beautiful colours: it was a foot in length, and had four paws, like the common lizards; but its head was flat, and had a small hole in the middle; the wings were very thin, and resembled those of a flying fish. About the neck were a sort of wattles, not unlike those of cocks, which gave it no disagreeable appearance. He intended to have preserved it, in order to bring it into Europe; but it was corrupted by the heat, before the close of the day: however, they have since been brought into England, and are now common enough in the cabinets of the curious.

The last animal of the lizard kind that I shall mention, is the Chalcidian lizard of Aldrovandus, very improperly called

the seps, by modern historians. This animal seems to make the shade that separates the lizard from the serpent race. It has four legs, like the lizard ; but so short, as to be utterly unserviceable in walking : it has a long slender body, like the serpent ; and it is said to have the serpent's malignity also. The fore legs are very near the head ; the hind legs are placed far backward ; but before and behind they seem rather useless incumbrances, than instruments serving to assist the animal in its motions, or in providing for its subsistence. These animals are found above three feet long, and thick in proportion, with a large head and pointed snout. The whole body is covered with scales ; and the belly is white, mixed with blue. It has four crooked teeth ; as also a pointed tail, which, however, can inflict no wound. Whether the teeth be similar to the viper's fangs, we are not told ; though Volteranus says, they are covered with a membrane ; by which I am apt to think he means a venom-bag, which is found at the root of the teeth of all serpents that are poisonous. It is viviparous ; fifteen young ones having been taken alive out of its belly. Upon the whole, it appears to bear a strong affinity to the viper ; and, like that animal, its bite may be dangerous.

C H A P. VIII.

Of Serpents in General.

WE now come to a tribe that not only their deformity, their venom, their ready malignity, but also our prejudices, and our very religion, have taught us to detest. The serpent has from the beginning been the enemy of man ; and it has hitherto continued to terrify and annoy him, notwithstanding all the arts which have been practised to destroy it. Formidable in itself, it deters the invader from the pursuit ; and

from its figure, capable of finding shelter in a little space, it is not easily discovered by those who would venture to try the encounter. Thus possessed at once of potent arms and inaccessible or secure retreats, it baffles all the arts of man, though never so earnestly bent upon its destruction.

For this reason, there is scarce a country in the world that does not still give birth to this poisonous brood, that seem formed to quell human pride, and repress the boasts of security. Mankind have driven the lion, the tiger and the wolf from their vicinity; but the snake and the viper still defy their power, and frequently punish their insolence.

Their numbers, however, are thinned by human assiduity; and it is possible some of the kinds are wholly destroyed. In none of the countries of Europe are they sufficiently numerous to be truly terrible; the philosopher can meditate in the fields without danger, and the lover seek the grove without fearing any wounds but those of metaphor. The various malignity that has been ascribed to European serpents of old, is now utterly unknown; there are not above three or four kinds that are dangerous, and their poison operates in all in the same manner. A burning pain in the part, easily removable by timely applications, is the worst effect that we experience from the bite of the most venomous serpents of Europe. The drowsy death, the starting of the blood from every pore, the insatiable and burning thirst, the melting down the solid mass of the whole form into one heap of putrefaction, these are horrors with which we are entirely unacquainted.

But though we have thus reduced these dangers, having been incapable of wholly removing them, in other parts of the world they still rage with all their ancient malignity. Nature seems to have placed them as centinels to deter mankind from spreading too widely, and from seeking new abodes till they have thoroughly cultivated those at home. In the warm countries that lie within the tropic, as well as in the cold regions of the north, where the inhabitants are few, the serpents propagate in equal proportion. But of all coun-

tries, those regions have them in the greatest abundance where the fields are unpeopled and fertile, and where the climate supplies warmth and humidity. All along the swampy banks of the river Niger or Oroonoko, where the sun is hot, the forest thick, and the men but few, the serpents cling among the branches of the trees in infinite numbers, and carry on an unceasing war against all other animals in their vicinity. Travellers have assured us that they have often seen large snakes twining round the trunk of a tall tree, encompassing it like a wreath, and thus rising and descending at pleasure. In these countries, therefore, the serpent is too formidable to become an object of curiosity, for it excites much more violent sensations.

We are not, therefore, to reject as wholly fabulous, the accounts left us by the ancients of the terrible devastations committed by a single serpent. It is probable, in early times, when the arts were little known, and mankind were but thinly scattered over the earth, that serpents continuing undisturbed possessors of the forest, grew to an amazing magnitude; and every other tribe of animals fell before them. It then might have happened, that serpents reigned the tyrants of a district for centuries together. To animals of this kind, grown by time and rapacity to a hundred or a hundred and fifty feet in length, the lion, the tiger, and even the elephant itself, were but feeble opponents. The dreadful monster spread desolation round him; every creature that had life was devoured or fled to a distance. That horrible *fætor* which even the commonest and the most harmless snakes are still found to diffuse, might, in these larger ones, become too powerful for any living being to withstand; and while they preyed without distinction, they might thus also have poisoned the atmosphere around them. In this manner, having for ages lived in the hidden and unpeopled forest, and finding, as their appetites were more powerful, the quantity of their prey decreasing, it is possible they might venture boldly from their retreats, into the more cultivated parts of the country, and carry consternation among mankind, as they had before de-

solation among the lower ranks of nature. We have many histories of antiquity, presenting us such a picture ; and exhibiting a whole nation sinking under the ravages of a single serpent. At that time man had not learned the art of uniting the efforts of many, to effect one great purpose. Opposing multitudes only added new victims to the general calamity, and increased mutual embarrassment and terror. The animal was therefore to be singly opposed by him who had the greatest strength, the best armour, and the most undaunted courage. In such an encounter, hundreds must have fallen ; till one, more lucky than the rest, by a fortunate blow, or by taking the monster in its torpid interval, and furcharged with spoil, might kill, and thus rid his country of the destroyer. Such was the original occupation of heroes ; and those who first obtained that name, from their destroying the ravagers of the earth, gained it much more deservedly than their successors, who acquired their reputation only for their skill in destroying each other. But as we descend into more enlightened antiquity, we find these animals less formidable, as being attacked in a more successful manner. We are told, that while Regulus led his army along the banks of the river Bagrada in Africa, an enormous serpent disputed his passage over. We are assured by Pliny, who says that he himself saw the skin, that it was a hundred and twenty feet long, and that it had destroyed many of the army. At last, however, the battering engines were brought out against it ; and these assailing it at a distance, it was soon destroyed. Its spoils were carried to Rome, and the general was decreed an ovation for his success. There are, perhaps, few facts better ascertained in history than this : an ovation was a remarkable honour ; and was given only for some single exploit, that did not deserve a triumph : no historian would offer to invent that part of the story at least, without being subject to the most shameful detection. The skin was kept for several years after in the capitol ; and Pliny says, he saw it there : now, though Pliny was a credulous writer, he was by no means a *false* one ; and whatever he says he has seen, we may very safely rely on. At

present, indeed, such ravages from serpents are scarce seen in any part of the world; not but that in Africa and America, some of them are powerful enough to brave the assaults of men to this day.

But happily for us, we are placed at such a distance as to take a view of this tribe, without fearing for our safety; we can survey their impotent malignity with the same delight with which the poet describes the terrors of a dead monster.

Nequeant expleri corda tuendo

Terribiles oculos villosaque fetis pectore.

To us their slender form, their undulating motion, their vivid colouring, their horrid stench, their forked tongue, and their envenomed fangs, are totally harmless; and in this country, their uses even serve to counterbalance the mischief they sometimes occasion.

If we take a survey of serpents in general, they have marks by which they are distinguished from all the rest of animated nature. They have the length and the suppleness of the eel, but want fins to swim with; they have the scaly covering and pointed tail of the lizard, but they want legs to walk with; they have the crawling motion of the worm, but, unlike that animal, they have lungs to breathe with: like all the reptile kind, they are resentful when offended; and nature has supplied them with terrible arms to revenge every injury.

Though they are possessed of very different degrees of malignity, yet they are all formidable to man, and have a strong similitude of form to each other; and it will be proper to mark the general characters before we descend to particulars. With respect to their conformation, all serpents have a very wide mouth, in proportion to the size of the head; and what is very extraordinary, they can gape and swallow the head of another animal which is three times as big as their own. I have seen a toad taken out of the belly of a snake, at lord Spencer's near London, the body of which was thrice the diameter of the animal that swallowed it. However, it is no way surprizing that the skin of the snake should stretch to re-

ceive so large a morsel; the wonder seems how the jaws could take it in. To explain this, it must be observed that the jaws of this animal do not open as ours, in the manner of a pair of hinges, where bones are applied to bones and play upon one another: on the contrary, the serpent's jaws are held together at the roots by a stretching muscular skin; by which means they open as widely as the animal chooses to stretch them, and admit of a prey much thicker than the snake's own body. The throat, like stretching leather, dilates to admit the morsel; the stomach receives it in part; and the rest remains in the gullet, till putrefaction and the juices of the serpent's body unite to dissolve it.

As to the teeth, I will talk more of them when I come to treat of the viper's poison; it will be sufficient here to observe, that some serpents have fangs, or canine teeth, and others are without them. The teeth in all are crooked and hollow; and by a peculiar contrivance, are capable of being erected or depressed at pleasure.

The eyes of all serpents are small, if compared to the length of the body; and though differently coloured in different kinds, yet the appearance of all is malign and heavy; and from their known qualities, they strike the imagination with the idea of a creature meditating mischief. In some, the upper eye-lid is wanting, and the serpent winks only with that below; in others, the animal has a nictitating membrane or skin, resembling that which is found in birds, which keeps the eye clean, and preserves the sight. The substance of the eye in all is hard and horny; the cristalline humour occupying a great part of the globe.

The holes for hearing are very visible in all: but there are no conduits for smelling; though it is probable that some of them enjoy that sense in tolerable perfection.

The tongue in all these animals is long and forky. It is composed of two long fleshy substances, which terminate in sharp points, and are very pliable. At the root, it is connected very strongly to the neck by two tendons, that give it a variety

of play. Some of the viper kind have tongues a fifth part of the length of their bodies ; they are continually darting them out, but they are entirely harmless, and only terrify those who are ignorant of the real situation of their poison.

If from the jaws we go on to the gullet, we shall find it very wide for the animal's size, and capable of being distended to a great degree ; at the bottom of this lies the stomach, which is not so capacious, and receives only a part of the prey, while the rest continues in the gullet for digestion. When the substance in the stomach is dissolved into chyle, it passes into the intestines, and from thence goes to nourishment, or to be excluded by the vent.

Like most other animals, serpents are furnished with lungs, which I suppose are serviceable in breathing, though we cannot perceive the manner in which this operation is performed : for though serpents are often seen apparently to draw in their breath, yet we cannot find the smallest signs of their ever respiring it again. Their lungs, however, are long and large, and doubtless are necessary to promote their languid circulation. The heart is formed as in the tortoise, the frog, and the lizard kinds, so as to work without the assistance of the lungs. It is single, the greatest part of the blood flowing from the great vein to the great artery by the shortest course. By this contrivance of nature, we easily gather two consequences ; that snakes are amphibious, being equally capable of living on land and in the water ; and, that also they are torpid in winter, like the bat, the lizard, and other animals formed in the same manner.

The vent in these animals serves for the emission of the urine and the fæces, and for the purposes of generation. The instrument of generation in the male is double, being forked like the tongue ; the ovaries in the female are double also ; and the aperture is very large, in order to receive the double instrument of the male. They copulate in their retreats ; and it is said by the ancients, that in this situation they appear like one serpent with two heads ; but how far this remark is found-

died in truth, I do not find any of the moderns that can resolve me.

As the body of this animal is long, slender, and capable of bending in every direction, the number of joints in the back-bone are numerous beyond what one would imagine. In the generality of quadrupeds, they amount to not above thirty or forty; in the serpent kind they amount to a hundred and forty-five from the head to the vent, and twenty-five more from that to the tail*. The number of these joints must give the back-bone a surprizing degree of pliancy; but this is still increased by the manner in which each of these joints are locked into the other. In man and quadrupeds, the flat surfaces of the bones are laid one against the other, and bound tight by sinews; but in serpents the bones play one within the other like ball and socket, so that they have full motion upon each other in every direction†. Thus if a man were to form a machine composed of so many joints as are found in the back of a serpent, he would find it no easy matter to give it such strength and pliancy at the same time. The chain of a watch is but a bungling piece of workmanship in comparison.

Though the number of joints in the back-bone is great, yet that of the ribs is still greater; for, from the head to the vent, there are two ribs to every joint, which make their number two hundred and ninety in all. These ribs are furnished with muscles; four in number; which being inserted into the head, run along to the end of the tail, and give the animal great strength and agility in all its motions.

The skin also contributes to its motions, being composed of a number of scales, united to each other by a transparent membrane, which grows harder as it grows older, until the animal changes, which is generally done twice a year. This cover then bursts near the head, and the serpent creeps from it, by an undulatory motion, in a new skin, much more vivid than the former. If the old slough be then viewed, every scale will be distinctly seen, like a piece of net-work, and

* Vide Charat, Anatom.

† Derham, p. 396.

will be found greatest where the part of the body they covered was largest.

There is much geometrical neatness in the disposal of the serpent's scales, for assisting the animal's sinuous motion. As the edges of the foremost scales lie over the ends of the following scales, so those edges, when the scales are erected, which the animal has a power of doing in a small degree, catch in the ground, like the nails in the wheel of a chariot, and so promote and facilitate the animal's progressive motion. The erecting these scales is by means of a multitude of distinct muscles, with which each is supplied, and one end of which is tacked each to the middle of the foregoing.

In some of the serpent kind there is the exactest symmetry in these scales; in others they are disposed more irregularly. In some there are larger scales on the belly, and often answering to the number of ribs; in others, however, the animal is without them. Upon this slight difference, Linnæus has founded his distinctions of the various classes of the serpent tribe, Human curiosity, however, and even human interest, seem to plead for a very different method of distribution. It is not the number of scales on a formidable animal's belly, nor their magnitude or variety, that any way excite our concern. The first question that every man will naturally ask, when he hears of a snake, is, whether it be large? the second, whether it be venomous? in other words, the strongest lines in the animal's history are those that first excite our attention; and these it is every historian's business to display.

When we come to compare serpents with each other, the first great distinction appears in their size; no other tribe of animals differing so widely in this particular. What, for instance, can be so remotely separated as the great liboya of Surinam, that grows to thirty-six feet long; and the little serpent, at the Cape of Good-Hope and the north of the river Senegal, that is not above three inches, and covers whole sandy deserts with its multitudes! this tribe of animals, like that of fishes, seems to have no bounds put to their growth: their

bones are in a great measure cartilaginous, and they are consequently capable of great extension ; the older, therefore, a serpent becomes, the larger it grows ; and as they seem to live to a great age, they arrive at an enormous size.

Leguat assures us, that he saw one in Java, that was fifty feet long. Carli mentions their growing to above forty feet ; and we have now the skin of one in the museum, that measures thirty-two. Mr. Wentworth, who had large concerns in the Brebices in America, assures me, that, in that country, they grow to an enormous length. He one day sent out a soldier, with an Indian, to kill wild fowl for the table ; and they accordingly went some miles from the fort : in pursuing their game, the Indian, who generally marched before, beginning to tire, went to rest himself upon the fallen trunk of a tree, as he supposed it to be ; but when he was just going to sit down, the enormous monster began to move, and the poor savage perceiving that he had approached a liboya, the greatest of all the serpent kind, dropped down in agony. The soldier, who perceived at some distance what had happened, levelled at the serpent's head, and, by a lucky aim, shot it dead : however, he continued his fire until he was assured the animal was killed ; and then going up to rescue his companion, who was fallen motionless by its side, he, to his astonishment, found him dead likewise, being killed by the fright. Upon his return to the fort, and telling what had happened, Mr. Wentworth ordered the animal to be brought up, when it was measured, and found to be thirty-six feet long. He had the skin stuffed, and then sent to Europe, as a present to the prince of Orange, in whose cabinet it is now to be seen at the Hague ; but the skin has shrunk, by drying, two or three feet.

In the East-Indies they grow also to an enormous size ; particularly in the island of Java, where, we are assured, that one of them will destroy and devour a buffalo. In a letter, printed in the German Ephemerides, we have an account of a combat between an enormous serpent and a buffalo, by a person, who

assures us, that he was himself a spectator. The serpent had for some time been waiting near the brink of a pool, in expectation of its prey ; when a buffalo was the first that offered. Having darted upon the affrighted animal, it instantly began to wrap it round with its voluminous twistings ; and, at every twist, the bones of the buffalo were heard to crack almost as loud as the report of a cannon. It was in vain that the poor animal struggled and bellowed ; its enormous enemy entwined it too closely to get free ; till, at length, all its bones being mashed to pieces, like those of a malefactor on the wheel, and the whole body reduced to one uniform mass, the serpent untwined its folds to swallow its prey at leisure. To prepare for this, and in order to make the body slip down the throat more glibly, it was seen to lick the whole body over, and thus cover it with its mucous. It then began to swallow it at that end that offered least resistance ; while its length of body was dilated to receive its prey, and thus took in at once a morsel that was three times its own thickness. We are assured by travellers, that these animals are often found with the body of a stag in their gullet, while the horns, which they are unable to swallow, keep sticking out at their mouths.

But it is happy for mankind that the rapacity of these frightful creatures is often their punishment ; for, whenever any of the serpent kind have gorged themselves in this manner, whenever their body is seen particularly distended with food, they then become torpid, and may be approached and destroyed with safety. Patient of hunger to a surprizing degree, whenever they seize and swallow their prey, they seem like surfeited gluttons, unwieldy, stupid, helpless, and sleepy : they at that time seek some retreat, where they may lurk for several days together, and digest their meal in safety : the smallest effort at that time is capable of destroying them ; they can scarce make any resistance ; and they are equally unqualified for flight or opposition ; that is the happy opportunity of attacking them with success ; at that time the naked Indian himself does not fear to assail them. But it is otherwise when this sleepy interval of digestion is over ; they then issue with famished appetites,

from their retreats, and with accumulated terrors, while every animal of the forest flies before them.

Carli describes the long serpent of Congo, making its track through the tall grass, like mowers in a summer's day. He could not, without terror, behold whole lines of grass lying levelled under the sweep of its tail. In this manner it moved forward with great rapidity, until it found a proper situation frequented by its prey: there it continued to lurk, in patient expectation, and would have remained for weeks together, had it not been disturbed by the natives.

Other creatures have a choice in their provision; but the serpent indiscriminately preys upon all; the buffalo, the tiger, and the gazelle. One would think that the porcupine's quills might be sufficient to protect it; but whatever has life, serves to appease the hunger of these devouring creatures: porcupines, with all their quills, have frequently been found in their stomachs, when killed and opened; nay, they most frequently are seen to devour each other.

A life of savage hostility in the forest, offers the imagination one of the most tremendous pictures in nature. In those burning countries, where the sun dries up every brook for hundreds of miles round; when what had the appearance of a great river in the rainy season, becomes, in summer, one dreary bed of sand; in those countries, I say, a lake that is never dry, or a brook that is perennial, is considered by every animal, as the greatest convenience of nature. As to food, the luxuriant landscape supplies that in sufficient abundance; it is the want of water that all animals endeavour to remove; and inwardly parched by the heat of the climate, traverse whole deserts to find out a spring. When they have discovered this, no dangers can deter them from attempting to slake their thirst. Thus the neighbourhood of a rivulet, in the heart of the tropical continents, is generally the place where all the hostile tribes of nature draw up for the engagement. On the banks of this little envied spot, thousands of animals of various kinds, are seen venturing to quench their thirst, or preparing to seize their

prey. The elephants are perceived in a long line, marching from the darker parts of the forest ; the buffalos are there depending upon numbers for security ; the gazelles relying solely upon their swiftness ; the lion and tiger waiting a proper opportunity to seize ; but chiefly the larger serpents are upon guard there, and defend the accesses of the lake. Not an hour passes without some dreadful combat ; but the serpent, defended by its scales, and naturally capable of sustaining a multitude of wounds, is, of all others, the most formidable. It is the most wakeful also ; for the whole tribe sleep with their eyes open, and are consequently for ever upon the watch : so that, till their rapacity is satisfied, few other animals will venture to approach their station.

But though these animals are, of all others, the most voracious, and though the morsel which they swallow without chewing, is greater than what any other creature, either by land or water, the whale itself not excepted, can devour, yet no animals upon earth, bear abstinence so long as they. A single meal, with many of the snake kind, seems to be the adventure of a season ; it is an occurrence for which they have been for weeks, nay, sometimes for months, in patient expectation of. When they have seized their prey, their industry for several weeks is entirely discontinued ; the fortunate capture of an hour often satisfies them for the remaining period of their annual activity. As their blood is colder than that of most other terrestrial animals, and as it circulates but slowly through their bodies, so their powers of digestion are but feeble. Their prey continues, for a long time, partly in the stomach, partly in the gullet ; and a part is often seen hanging out of the mouth. In this manner it digests by degrees ; and in proportion as the part below is dissolved, the part above is taken in. It is not therefore till this tedious operation is entirely performed, that the serpent renews its appetite and its activity. But should any accident prevent it from issuing once more from its cell, it still can continue to bear famine, for weeks, months, nay, for years together. Vipers are often kept in boxes for six or eight months, without any food whatever ; and there are little ser-

pents sometimes sent over to Europe, from Grand Cairo, the name of which I have not been able to learn, that live for several years in glasses, and never eat at all, nor even stain the glass with their excrements. Thus the serpent tribe unite in themselves two very opposite qualities; wonderful abstinence, and yet incredible rapacity.

If leaving the consideration of their appetites, we come to compare serpents as to their voices, some are found silent, some have a peculiar cry, but hissing is the sound which they most commonly send forth, either as a call to their kind, or as a threat to their enemies. In the countries where they abound, they are generally silent in the middle of the day, when they are obliged to retire from the heat of the climate; but as the cool of the evening approaches, they are then heard issuing from their cells, with continued hissings; and such is the variety of their notes, that some have assured me, they very much resemble the music of an English grove. This, some will hardly credit: at any rate, such notes, however pleasing, can give but very little delight, when we call to mind the malignity of the minstrel. If considered, indeed, as they answer the animal's own occasions, they will be found well adapted to its nature, and fully answering the purposes of terrifying such as would venture to offend it.

With respect to motion, some serpents, particularly those of the viper kind, move slowly; while others, such as the ammodytes, dart with amazing swiftness. The motion in all is similar; but the strength of body in some, gives a very different appearance. The viper, that is but a slow, feeble-bodied animal, makes way in a heavy undulating manner; advancing its head, then drawing up its tail behind, and bending the body into a bow; then from the spot where the head and tail were united, advancing the head forward as before. This, which is the motion of all serpents, is very different from that of the earth-worm, or the naked snail. The serpent, as was said above, has a back-bone, with numerous joints; and this bone the animal has a power of bending in every direction, but without being

able to shorten or lengthen it at pleasure. The earth-worm, on the other hand, has no back-bone; but its body is composed of rings, which, like a barber's puff, it can lengthen or shorten as it finds necessary. The earth-worm, therefore, in order to move forward, lengthens the body; then, by the fore part, clings to the ground, where it has reached, and then contracts and brings up its rear: then, when the body is thus shortened, the fore-part is lengthened again for another progression; and so on. The serpent, instead of shortening the body, bends it into an arch; and this is the principal difference between serpentine and vermicular progression.

I have instanced this motion in the viper, as most easily discerned; but there are many serpents that dart with such amazing swiftness, that they appear rather to leap than crawl. It is most probable, however, that no serpent can dart upon even ground farther than its own length, at one effort. Our fears, indeed, may increase the force of their speed, which is sometimes found so fatal. We are told by some, that they will dart to a very great distance; but this my enquiries have never been able to ascertain. The manner of progression in the swiftest serpent we know, which is the jaculus, is by instantly coiling itself upon its tail, and darting from thence to its full extent; then carrying the tail, as quick as lightning, to the head; coiling and darting again; and by this means proceeding with extreme rapidity, without ever quitting the ground. Indeed, if we consider the length and the weakness of the back-bone in all these animals; if we regard the make of their vertabræ, in which we shall find the junctures all formed to give play, and none to give power; we cannot be of opinion that they have a faculty of springing from the ground, as they entirely want a *fulcrum*, if I may so express it, from whence to take their spring; the whole body being composed of unsupported muscles and joints that are yielding. It must be confessed, that they dart down from trees upon their prey; but their weight alone is sufficient for that purpose, without much effort of their own.

Though all serpents are amphibious, some are much fonder of the water than others; and though destitute of fins or gills, remain at the bottom, or swim along the surface with great ease. From their internal structure, just sketched above, we see how well adapted they are for either element; and how capable their blood is of circulating at the bottom, as freely as in the frog or the tortoise. They can, however, endure to live in fresh water only; for salt is an effectual bane to the whole tribe. The greatest serpents are most usually found in fresh-water, either choosing it as their favourite element, or finding their prey in such places in the greatest abundance. But that all will live and swim in liquids, appears from the experiment of Rhedi; who put a serpent into a large glass vessel of wine, where it lived swimming about six hours; though, when it was by force immersed and kept under that liquid, it lived only one hour and a half. We put another in common water, where it lived three days; but when it was kept under water, it lived only about twelve hours*. Their motion there, however, is perfectly the reverse of what it is upon land; for, in order to support themselves upon an element lighter than their bodies, they are obliged to increase their surface in a very artificial manner. On earth their windings are perpendicular to the surface; in water they are parallel to it: in other words, if I should wave my hand up and down, it will give an idea of the animal's progress on land; if I should wave it to the right and left, it will give some idea of its progress on the water.

Some serpents have a most horrible factor attending them, which is alone capable of intimidating the brave. This proceeds from two glands near the vent, like those in the weasel or polecat; and, like those animals, in proportion as they are excited by rage or by fear, the scent grows stronger. It would seem, however, that such serpents as are most venomous, are least offensive in this particular; since the rattlesnake and the viper have no smell whatever: nay, we are told, that at Calcut and Cranganon, in the East-Indies, there are some very noxious serpents, who are so far from being disagreeable, that their

* Rhedi, Exper. p. 170.

excrements are sought after, and kept as the most pleasing perfume. The Esculapian serpent is also of this number.

Some serpents bring forth their young alive; as the viper; some bring forth eggs, which are hatched by the heat of their situation; as the common black-snake, and the majority of the serpent tribe. When a reader, ignorant of anatomy, is told, that some of those animals produce their young alive, and that some produce eggs only, he is apt to suppose a very great difference in the internal conformation, which makes such a variety in the manner of bringing forth. But this is not the case: these animals are internally alike, in whatever manner they produce their young; and the variety in their bringing forth, is rather a slight than a real discrimination. The only difference is, that the viper hatches her eggs, and brings them to maturity within her body; the snake is more premature in her productions, and sends her eggs into the light, some time before the young ones are capable of leaving the shell. Thus, if either are opened, the eggs will be found in the womb, covered with their membranous shell, and adhering to each other, like large beads on a string. In the eggs of both, young ones will be found, though at different stages of maturity: those of the viper will crawl and bite the moment the shell that encloses them is broke open; those of the snake are not yet arrived at their perfect form.

Father Labat took a serpent of the viper kind, that was nine feet long, and ordered it to be opened in his presence. He then saw the manner in which the eggs of these animals lie in the womb. In this creature there were six eggs, each of the size of a goose egg, but longer, more pointed, and covered with a membranous skin, by which also they were united to each other. Each of these eggs contained from thirteen to fifteen young ones, about six inches long, and as thick as a goose-quill. Though the female from whence they were taken was spotted, the young seemed to have a variety of colours very different from the parent; and this led the traveller to suppose that the colour was no characteristic mark among serpents.

These little mischievous animals were no sooner let loose from the shell, than they crept about, and put themselves into a threatening posture, coiling themselves up and biting the stick with which he was destroying them. In this manner he killed seventy-four young ones; those that were contained in one of the eggs, escaped at the place where the female was killed, by the bursting of the egg and their getting among the bushes.

The last distinction that I shall mention, but the most material among serpents, is, that some are venomous and some inoffensive. If we consider the poison of serpents as it relates to man, there is no doubt but that it is a scourge and an affliction. The various calamities that the poison of serpents is capable of producing, are not only inflicted by the animal itself, but by men more mischievous even than serpents, who prepare their venom to destroy each other. With this, savages poison their arms, and also prepare their revengeful potions. The ancients were known to preserve it for the purposes of suicide; and even among semi-barbarous countries at this day, the venom of snakes is used as a philtre.

But, though the poison be justly terrible to us, it has been given to very good purposes for the animal's own proper support and defence. Without this, serpents, of all other animals, would be the most exposed and defenceless; without feet for escaping a pursuit; without teeth capable of inflicting a dangerous wound, or without strength for resistance; incapable, from their size, of finding security in very small retreats, like the earth-worm, and disgusting all from their deformity, nothing was left for them but a speedy extirpation. But furnished as they are with powerful poison, every rank of animals approach them with dread, and never seize them but at an advantage. Nor is this all the advantage they derive from it. The malignity of a few, serves for the protection of all. Though not above a tenth of their number are actually venomous, yet the similitude they all bear to each other, excites a general terror of the whole tribe; and the uncertainty of their enemies in which the poison chiefly resides, makes even the most harm-

less formidable. Thus, providence seems to have acted with double precaution; it has given some of them poison for the general defence of a tribe naturally feeble; but it has thinned the numbers of those which are venomous, lest they should become too powerful for the rest of animated nature.

From these noxious qualities in the serpent kind, it is no wonder that not only man, but beasts and birds, carry on an unceasing war against them. The ichneumon of the Indians, and the peccary of America, destroy them in great numbers. These animals have the art of seizing them near the head; and, it is said, that they can skin them with great dexterity. The vulture and the eagle also prey upon them in great abundance; and often sousing down from the cloud, drop upon a long serpent, which they snatch up, struggling and writhing in the air. Dogs also are bred up to oppose them. Father Feuillée tells us, that being in the woods of Martinico, he was attacked by a large serpent, which he could not easily avoid, when his dog immediately came to his relief, and seized the assailant with great courage. The serpent entwined him, and pressed him so violently, that the blood came out of his mouth, and yet the dog never ceased till he had tore it to pieces. The dog was not sensible of his wounds, during the fight; but soon after his head swelled prodigiously, and he lay on the ground as dead. But his master having found hard by, a banana tree, he applied its juice, mixed with treacle, to the wounds, which recovered the dog, and quickly healed his sores.

But it is in man that these venomous creatures find the most dangerous enemy. The *psylli*, of old, were famous for charming and destroying serpents. Some moderns pretend to the same art. Cassaubon says, that he knew a man who could at any time summon a hundred serpents together, and draw them into the fire. Upon a certain occasion, when one of them, bigger than the rest, would not be brought in, he only repeated his charm, and it came forward, like the rest, to submit to the flames. Philostratus describes particularly, how the Indians charm serpents. "They take a scarlet robe embroidered with golden letters, and spread it before a serpent's hole. The golden

letters have a fascinating power ; and by looking stedfastly, the serpent's eyes are overcome and laid asleep." These, and many other feats, have been often practised upon these animals by artful men, who had first prepared the serpents for their exercise, and then exhibited them as adventitiously assembled at their call. In India there is nothing so common as dancing serpents, which are carried about in a broad flat vessel somewhat resembling a sieve. These erect and put themselves in motion at the word of command. When their keeper sings a slow tune, they seem by their heads to keep time ; when he sings a quicker measure, they appear to move more brisk and lively. All animals have a certain degree of docility ; and we find that serpents themselves can be brought to move and approach at the voice of their master. From this trick successfully practised before the ignorant, it is most probable has arisen all the boasted pretensions which some have made to charming of serpents ; an art to which the native Americans pretend at this very day. One of Linnæus's pupils, we are told, purchased the secret from an Indian, and then discovered it to his master ; but, like all secrets of the kind, it is probable this ended in a few unmeaning words of no efficacy.

Though the generality of mankind regard this formidable race with horror, yet there have been some nations, and there are some at this day, that consider them with veneration and regard. The adoration paid by the ancient Egyptians to a serpent is well known : many of the nations at present, along the western coasts of Africa, retain the same unaccountable veneration. Upon the gold and slave coasts, a stranger, upon entering the cottages of the natives, is often surprized to see the roof swarming with serpents, that cling there without molesting and unmolested by the natives. But his surprize will increase upon going farther southward to the kingdom of Widah, when he finds that a serpent is the god of the country. This animal, which travellers describe as a huge overgrown creature, has its habitation, its temple, and its priests. These impress the vulgar with an opinion of its virtues ; and numbers are daily seen to offer not only their goods, their provi-

sions, and their prayers, at the shrine of their hideous deity, but also their wives and daughters. These the priests readily accept of, and after some days of penance, return them to their suppliants, much benefited by the serpent's supposed embraces. Such a complicated picture of ignorance and imposture gives no very favourable impressions of our fellow-creatures; but we may say, in defence of human nature, that the most frightful of reptiles is worshipped by the most uncultivated and barbarous of mankind.

From this general picture of the serpent tribe, one great distinction obviously presents itself; namely, into those that are venomous, and those that are wholly destitute of poison. To the first belong the viper, the rattle-snake, the cobra di capello, and all their affinities: to the other, the common black snake, the liboya, the boiguacu, the amphisbæna, and various others, that, though destitute of venom, do not cease to be formidable. I will therefore give their history separately, beginning with the venomous class, as they have the strongest claims to our notice and attention.

C H A P. IX.

Of venomous Serpents in General.

THE poison of serpents has been for ages one of the greatest objects of human consideration. To us who seldom feel the vengeful wound, it is merely a subject of curiosity; but to those placed in the midst of the serpent tribe, who are every day exposed to some new disaster, it becomes a matter of the most serious importance. To remedy the bite of a serpent is considered among our physicians as one of the slightest operations in medicine: but among the physicians of the east, the antidotes for this calamity make up the bulk of their dispensaries. In our colder climates, the venom does not ap-

pear with that instantaneous operation which it exhibits in the warmer regions; for either its powers are less exquisite, or our fluids are not carried round in such rapid circulation.

In all countries, however, the poison of the serpent is sufficiently formidable to deserve notice, and to excite our attention to its nature and effects. It will therefore, in the first place, be proper to describe its seat in the animal, as also the instrument by which the wound is made and the poison injected. In all this venomous class of reptiles, whether the viper, the rattle-snake, or the cobra di capello, there are two large teeth or fangs that issue from the upper jaw, and that hang out beyond the lower. The rest of the snake tribe are destitute of these; and it is most probable that wherever these fangs are wanting, the animal is harmless; on the contrary, wherever they are found it is to be avoided as the most pestilent enemy. These are the instruments that seem to place the true distinction between animals of the serpent kind; the wounds which these fangs inflict produce the most dangerous symptoms; the wounds inflicted by the teeth only, are attended with nothing more than the ordinary consequences attending the bite of any other animal. Our first great attention, therefore, upon seeing a serpent, should be directed to the teeth. If it has the fang teeth, it is to be placed among the venomous class; if it wants them, it may be set down as inoffensive. I am not ignorant that many serpents are said to be dangerous whose jaws are unfurnished with fangs; but it is most probable that our terrors only have furnished these animals with venom; for, of all the tribe whose teeth are thus formed, not one will be found to have a bag for containing poison, nor a conduit for injecting it into the wound. The black snake, the liboya, the blind worm, and a hundred others that might be mentioned, have their teeth of an equal size, fixed into the jaws, and with no other apparatus for inflicting a dangerous wound than a dog or a lizard; but it is otherwise with the venomous tribe we are now describing; these are well furnished, not only with an elaboratory where the poison is formed, but a canal by

which it is conducted to the jaw, a bag under the tooth for keeping it ready for every occasion, and also an aperture in the tooth itself for injecting it into the wound. To be more particular, the glands, that serve to fabricate this venomous fluid, are situated on each side of the head behind the eyes, and have their canals leading from thence to the bottom of the fangs in the upper jaw, where they empty into a kind of bladder, from whence the fangs on each side are seen to grow. The venom contained in this bladder is a yellowish thick tasteless liquor, which, injected into the blood, is death, yet which may be swallowed without any danger.

The fangs that give the wound come next under observation: they are large in proportion to the size of the animal that bears them: crooked, yet sharp enough to inflict a ready wound. They grow one on each side, and sometimes two, from two moveable bones in the upper jaw, which, by sliding backward or forward, have a power of erecting or depressing the teeth at pleasure. In these bones are also fixed many teeth, but no way venomous, and only serving to take and hold the animal's prey. Besides this apt disposition of the fangs, they are hollow within, and have an opening towards the point like the slit of a pen, through which, when the fang is pressed down upon the bladder where it grows, there is seen to issue a part of the venom that lay below. To describe this operation at once, when the serpent is irritated to give a venomous wound, it opens its formidable jaws to the widest extent; the moveable bones of the upper jaw slide forward; the fangs that lay before inclining are thus erected; they are struck with force into the flesh of the obnoxious person; by meeting resistance at the points, they press upon the bladders of venom from whence they grow; the venom issues up through the hollow of the tooth; and is pressed out through its slit into the wound, which by this time the tooth has made in the skin. Thus from a slight puncture, and the infusion of a drop of venom scarce larger than the head of a pin, the part is quickly inflamed, and, without a proper antidote, the whole frame contaminated.

The appearances which this venom produces are different, according to the serpent that wounds, or the season, or the strength of the animal that strikes the blow. If a viper inflicts the wound, and the remedy be neglected, the symptoms are not without danger. It first causes an acute pain in the place affected, attended with a swelling, first red, and afterwards livid. This, by degrees, spreads to the neighbouring parts; great faintness, and a quick, though low and interrupted pulse ensues: to this succeed great sickness at the stomach, bilious and convulsive vomitings, cold sweats, pains about the navel, and death itself. But the violence of these symptoms depend much on the season of the year, the difference of the climate, the size or rage of the animal, and the depth and situation of the wound. These symptoms are much more violent, and succeed each other more rapidly after the bite of a rattlesnake; but when the person is bit by the cobra di capello, he dies in an hour, his whole frame being dissolved into a putrid mass of corruption.

Nothing surely can more justly excite our wonder than that so small a quantity of venom should produce such powerful and deadly effects. If the venom itself be examined through a microscope, it will be found to shoot into little crystals, that, to an imagination already impressed with its potency, look like so many darts fit for entering the blood vessels, and wounding their tender coats. But all these darts are wholly of our own making; the softest, mildest fluid whatever, possessed of any consistency, will form crystals under the eye of the microscope, and put on an appearance exactly like the venom of the viper. In fact, this venom has no acrid taste whatever; and to all experiments that our senses can make upon it, appears a slimy insipid fluid. Charas, who often tasted it, assures us of the fact: and asserts, that it may be taken inwardly without any sensible effects, or any prejudice to the constitution. But the famous experiments that were tried by Redi and others, in the presence of the great duke of Tuscany and his court, put this beyond any doubt whatsoever. By these it appeared, that the serpent having once bitten, exhaus-

ted for that time, the greatest part of its poison ; and though the wound caused by its biting a second time was attended with some malignant symptoms, yet they were much milder than before. It appeared that the serpent biting upon a sponge, or a piece of soft bread, and then biting a dog immediately after, did not inflict a wound more dangerous than the prick of a needle. It appeared that the venom being collected, and a needle dipped therein, this produced almost as painful effects as the tooth of the animal itself. But what caused the greatest surprize in the court was, the seeming rashness of one Tozzi, a viper-catcher ; who, while the philosophers were giving elaborate lectures on the danger of the poison when taken internally, boldly desired a large quantity of it might be put together ; and then, with the utmost confidence, drank it off before them all. The court was struck with astonishment, and expected that the man would instantly fall dead ; but they soon perceived their mistake, and found, that taken in this manner, the poison was as harmless as water ; so true is that famous passage of Lucan,

Noxia serpentum est admixto sanguine pessis :

Morsu virus habent, et fatum in dente minantur :

Pocula morte carent.

What then shall we say to the speedy effect of so seemingly harmless a liquid taken into the circulation ? let us first observe, that milk is one of the most mild and nourishing of all fluids, and seeming the most friendly to the human constitution ; yet if milk be injected into a vein, it will quickly become fatal, and kill with more certain destruction than even the venom of the viper. From hence, then, we may infer, that the introducing not only the serpentine venom, but also a quantity of any other mixture, into the circulation, will be fatal ; and that, consequently, serpents kill as well by their power of injecting the wound as by the potency of their poison. Some indeed may inject a more acrimonious mixture, and this may produce more speedy effects ; but any mixture thus injected would be dangerous, and many would be fatal.

Ray gives us an instance of the potency of the serpent poison; which, though it has all the air of a fable, I cannot help transcribing. "A gentleman who went over to the East-Indies, while he was one day sitting among some friends, was accosted by an Indian juggler, who offered to show him some experiments respecting the venom of serpents; an exhibition usual enough in that country. Having first, therefore, produced a large serpent, he assured the company that it was harmless; and, to convince them of what he said, he tied up his arm, as is usual with those who are going to be bled, and whipped the serpent till it was provoked to bite him. Having drawn in this manner about half a spoonful of blood from his arm, he put the congealed clot upon his thigh. He then took out a much smaller serpent, which was no other than the cobra di capello; and having tied up its neck, he procured about half a drop of its venom, which he sprinkled on the clot of blood on his thigh, which instantly began to ferment and bubble, and soon changed colour from a red into a yellow."

This he pretended was caused by the extreme malignity of that animal's venom; however, I have no doubt that the whole is either a fable, or a trick of the Indian; who while he seemed to mix the serpent's venom, actually infused some stronger ingredient, some mineral acid, into the mass of blood, which was capable of working such a change. It cannot be supposed that any animal poison could act so powerfully upon the blood already drawn and coagulated; for a poison that could operate thus instantaneously upon cold blood, could not fail of soon destroying the animal itself.

Be this as it will, the effects of serpent poison are but too well known, though the manner of operation be not so clear. As none of this malignant tribe grow to a great size, the longest of them not exceeding nine feet, they seldom seek the combat with larger animals, or offend others till they are first offended. Did they exert their malignity in proportion to their power, they could easily drive the ranks of nature before them,

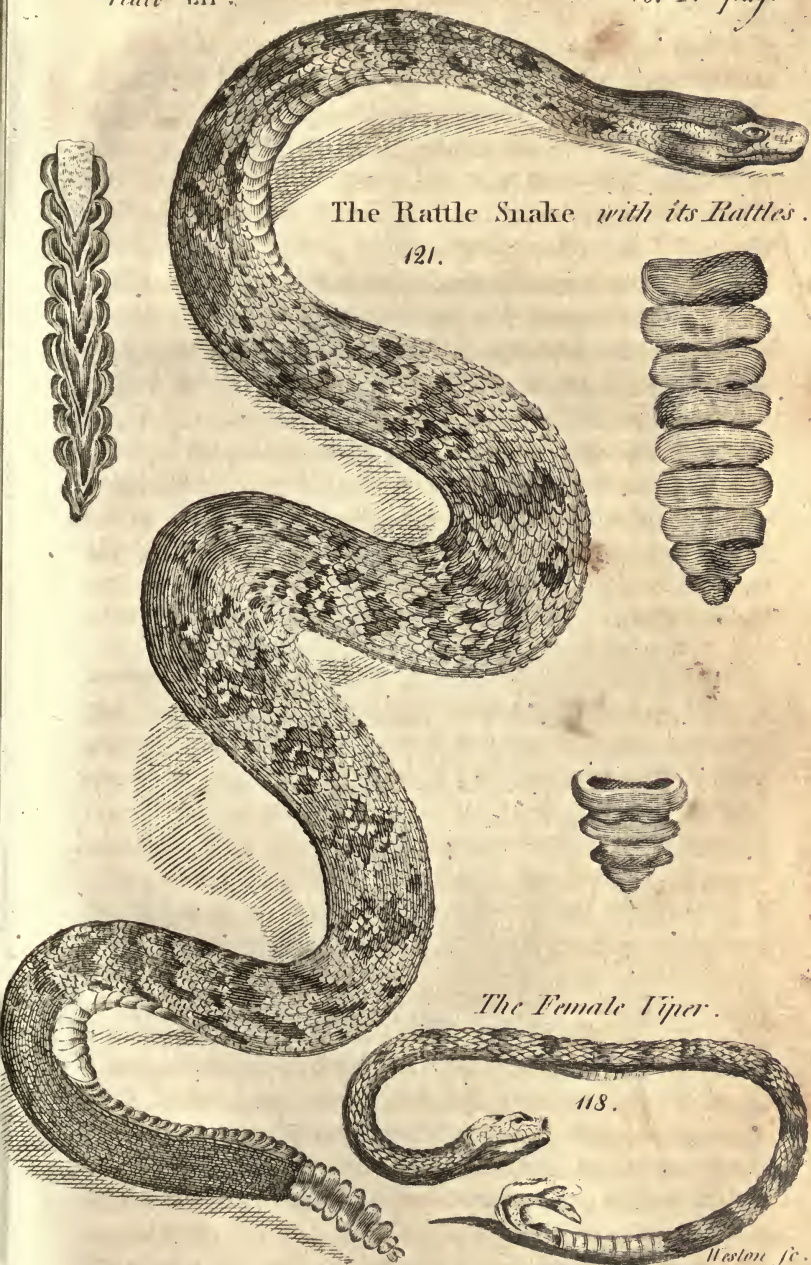
but they seem unconscious of their own superiority, and rather fly than offer to meet the meanest opposer. Their food chiefly consists of small prey, such as birds, moles, toads and lizards; so that they never attack the more formidable animals that would seldom die unrevenge. They lurk therefore in the clefts of rocks, or among stony places; they twine round the branches of trees, or sun themselves in the long grass at the bottom. There they only seek repose and safety. If some unwary traveller invades their retreats, their first effort is to fly; but when either pursued or accidentally trod upon, they then make a fierce and fatal resistance. For this purpose, they raise themselves according to their strength upon their tail, erect the head, seize the limb that presses them, the wound is given, and the head withdrawn in a moment. It is not therefore without reason, that the Asiatics, who live in regions where serpents greatly abound, wear boots and long clothes, which very well protect their lower parts from the accidental resentment of their reptile annoyers.

In the eastern and western Indies, the number of noxious serpents is various; in this country we are acquainted only with one. The viper is the only animal in Great-Britain from whose bite we have any thing to fear. In the tropical climates, the rattle-snake, the whip-snake, and the cobra di capello, are the most formidable, though by no means the most common. From the general notoriety of these particular serpents, and the universal terror which they occasion, it would seem that few others are possessed of such powerful malignity.

Vipers are found in many parts of this island; but the dry, stony, and, in particular the chalky, countries abound with them. This animal seldom grows to a greater length than two feet; though sometimes they are found above three. The ground colour of their bodies is a dirty yellow; that of the female is deeper. The back is marked the whole length with a series of rhomboid black spots, touching each other at the points; the sides with triangular ones, the belly entirely black. It is chiefly distinguished from the common black snake by

The Rattle Snake with its Rattles.

121.



the colour, which in the latter is more beautifully mottled, as well as by the head, which is thicker than the body; but particularly by the tail, which in the viper, though it ends in a point, does not run tapering to so great a length as in the other. When, therefore, other distinctions fail, the difference of the tail can be discerned at a single glance,

The viper differs from most other serpents in being much slower, as also in excluding its young completely formed, and bringing them forth alive. The kindness of providence seems exerted not only in diminishing the speed, but also the fertility, of this dangerous creature. They copulate in May, and are supposed to be about three months before they bring forth, and have seldom above eleven eggs at a time. These are of a size of a black-bird's eggs, and chained together in the womb like a string of beads. Each egg contains from one to four young ones; so that the whole of a brood may amount to about twenty or thirty. They continue in the womb till they come to such perfection as to be able to burst from the shell; and they are said by their own efforts, to creep from their confinement into the open air, where they continue for several days without taking any food whatsoever. "We have been often assured," says Mr. Pennant, "by intelligent people, of the truth of a fact, that the young of the viper, when terrified, will run down the throat of the parent, and seek shelter in its belly in the same manner as the young of the opossum retire into the ventral pouch of the old one. From this," continues he, "some have imagined that the viper is so unnatural as to devour its own young; but this deserves no credit, as these animals live upon frogs, toads, lizards and young birds, which they often swallow whole, though the morsel is often three times as thick as their own body.

The viper is capable of supporting very long abstinence, it being known that some have been kept in a box six months without food; yet during the whole time they did not abate of their vivacity. They feed only a small part of the year, but never during their confinement; for if mice, their fa-

vourite diet, should at that time be thrown into their box, though they will kill, yet they will never eat them. When at liberty, they remain torpid throughout the winter ; yet, when confined, have never been observed to take their annual repose. Their poison, however, decreases in proportion to the length of their confinement ; and it is thought, that the virtues of the animal's flesh are, by the same restraints, considerably lessened.

They are usually taken with wooden tongs, by the end of the tail, which may be done without danger ; for, while held in that position, they are unable to wind themselves up to hurt their enemy : yet, notwithstanding this precaution, the viper-catchers are frequently bit by them ; but, by the application of olive-oil, the bite is effectually cured.

One William Oliver, a viper-catcher at Bath, was the first who discovered this admirable remedy. On the first of June, 1735, in the presence of a great number of persons, he suffered himself to be bit by an old black viper, brought by one of the company, upon the wrist, and joint of the thumb of the right hand, so that drops of blood came out of the wounds : he immediately felt a violent pain both at the top of his thumb, and up his arm, even before the viper was loosened from his hand ; soon after he felt a pain, resembling that of burning, trickle up his arm ; in a few minutes his eyes began to look red and fiery, and to water much ; in less than an hour he perceived the venom seize his heart, with a pricking pain, which was attended with faintness, shortness of breath, and cold sweats ; in a few minutes after this, his belly began to swell, with great gripings, and pains in his back, which were attended with vomitings and purgings : during the violence of these symptoms, his sight was gone for several minutes, but he could hear all the while. He said, that in his former experiments, he had never deferred making use of his remedy longer than he perceived the effects of the venom reaching his heart ; but this time, being willing to satisfy the company thoroughly, and trusting to the speedy effects of his remedy,

which was nothing more than olive-oil, he forbore to apply any thing, till he found himself exceeding ill and quite giddy. About an hour and a quarter after the first of his being bit, a chaffing-dish of glowing charcoal was brought in, and his naked arm was held over it, as near as he could bear, while his wife rubbed in the oil with her hand, turning his arm continually round, as if she would have roasted it over the coals : he said the poison soon abated, but the swelling did not diminish much. Most violent purgings and vomitings soon ensued ; and his pulse became so low, and so often interrupted, that it was thought proper to order him a repetition of cordial potions : he said he was not sensible of any great relief from these ; but that a glass or two of olive-oil drank down, seemed to give him ease. Continuing in this dangerous condition, he was put to bed, where his arm was again bathed over a pan of charcoal, and rubbed with olive-oil, heated in a ladle over the charcoal, by dr. Mortimer's direction, who was the physician that drew up the account. From this last operation, he declared that he found immediate ease, as though by some charm : he soon after fell into a profound sleep, and after about nine hours found rest, awaked about six the next morning, and found himself very well ; but in the afternoon, on drinking some rum and strong beer, so as to be almost intoxicated, the swelling returned, with much pain and cold sweats, which abated soon, on bathing the arm, as before, and wrapping it up in a brown paper, soaked in the oil.

Such are the effects of the viper's bite ; yet its flesh has long been celebrated as a noble medicine. A broth, made by boiling one viper in a quart of water till it comes to a pint, is the usual method in which it is given at present ; and it is said to be a very powerful restorative in battered constitutions : the salt of vipers is also thought to exceed any other animal salt whatever, in giving vigour to the languid circulation, and prompting to venery.

The rattle-snake is bred in America, and in no part of the

old world. Some are as thick as a man's leg, and six feet in length; but the most usual size is from four to five feet long. In most particulars it resembles the viper; like that animal, having a large head and a small neck, being of a dusky colour, and furnished with fangs that inflict the most terrible wounds. It differs, however, in having a large scale, which hangs like a pent-house over each eye. The eye also is furnished with a nictitating membrane, that preserves it from dust; and its scales are of a considerable degree of hardness. They are of an orange, tawny, and blackish colour on the back; and of an ash-colour on the belly, inclining to lead. The male may be readily distinguished from the female, by a black velvet spot on the head, and by the head being smaller and longer. But that which, besides their superior malignity, distinguishes them from all other animals, is their rattle, an instrument lodged in their tail, by which they make such a loud, rattling noise, when they move, that their approach may readily be perceived, and the danger avoided. This rattle, which is placed in the tail, somewhat resembles, when taken out of the body, the curb chain of a bridle: it is composed of several thin, hard, hollow bones, linked to each other, and rattling upon the slightest motion. It is supposed by some, that the snake acquires an additional bone every year; and that, from hence, its age may be precisely known: however this may be, certain it is, that the young snakes of a year or two old, have no rattles at all; while many old ones have been killed that had from eleven to thirteen joints to each. They shake and make a noise with these rattles with prodigious quickness when they are disturbed; however, the peccary and the vulture are no way terrified at the sound, but hasten, at the signal, to seize the snake, as their most favourite prey.

It is very different with almost every other animal. The certain death which ensues from this terrible creature's bite, makes a solitude wherever it is heard. It moves along with the most majestic rapidity; neither seeking to offend the larger animals, nor fearing their insults. If unprovoked, it never med-

dies with any thing but its natural prey ; but when accidentally trod upon, or pursued to be destroyed, it then makes a dreadful and desperate defence. It erects itself upon its tail, throws back the head, and inflicts its wound in a moment ; then parts and inflicts a second wound : after which, we are told, by some, that it remains torpid and inactive, without even attempting to escape.

The very instant the wound is inflicted, though small in itself, it appears more painful than the sting of a bee. This pain, which is so suddenly felt, far from abating, grows every moment more excruciating and dangerous : the limb swells ; the venom reaches the head, which is soon of a monstrous size ; the eyes are red and fiery ; the heart beats quick, with frequent interruptions : the pain becomes insupportable, and some expire under it in five or six hours ; but others, who are of stronger constitutions, survive the agony for a few hours longer, only to sink under a general mortification, which ensues, and corrupts the whole body.

As a gentleman in Virginia was walking in the fields for his amusement, he accidentally trod upon a rattle-snake, that had been lurking in a stony place ; which, enraged by the pressure, reared up, bit his hand, and shook its rattles. The gentleman readily perceived that he was in the most dreadful danger ; but unwilling to die unrevenged, he killed the snake, and carrying it home in his hand, threw it on the ground before his family, crying out, I am killed, and there is my murderer ! in such an extremity the speediest remedies were the best. His arm, which was beginning to swell, was tied up near the shoulder, the wound was anointed with oil, and every precaution taken to stop the infection. By the help of a very strong constitution, he recovered ; but not without feeling the most various and dreadful symptoms for several weeks together. His arm, below the ligature, appeared of several colours, with a writhing among the muscles, that, to his terrified imagination, appeared like the motions of the animal that had wounded him. A fever ensued ; the loss of his hair,

giddiness, drought, weakness, and nervous faintings : till, by slow degrees, a very strong habit overpowered the latent malignity of the poison.

Several remedies have been tried to alleviate this calamity. A decoction of the Virginian snake-root is considered as the most effectual ; and, at the same time, the head of the animal bruised and laid upon the part affected, is thought to assist the cure. In general, however, it is found to be fatal ; and the Indians, sensible of this, take care to dip their arrows in the poison under the rattle snake's fangs, when they desire to take a signal revenge of their enemies.

Thus much concerning this animal is agreed upon by every naturalist ; there are other circumstances in its history, which are not so well ascertained. And first, is motion, which some describe as the swiftest imaginable ; asserting, that its Indian name of *ecacoalt*, which signifies the wind-serpent, implies its agility : others, on the contrary, assert that it is the slowest and the most sluggish of all serpents ; and that it seldom moves from one place. In this opposition of opinions, there are others, who assert, that on even ground it moves but slowly ; but then, among rocks, that it goes at a great rate. If we may argue from analogy, the opinion of those who contend for its slow motion, seems the most probable ; as the viper, which it so very much resembles, is remarkable among serpents for its inactivity.

It is said also by some that the rattle-snake has a power of charming its prey into its mouth ; and this is as strongly contradicted by others. The inhabitants of Pennsylvania are said to have opportunities of observing this strange fascination every day. The snake is often seen basking at the foot of a tree, where birds and squirrels make their residence. There, coiled upon its tail, its jaws extended, and its eyes shining like fire, the rattle-snake levels its dreadful glare upon one of the little animals above. The bird or the squirrel, which ever it may be, too plainly perceives the mischief meditating against it, and hops from branch to branch, with a timorous, plaintive

found, wishing to avoid, yet incapable of breaking through the fascination ; thus it continues for some time its feeble efforts and complaints, but is still seen approaching lower and lower towards the bottom branches of the tree, until, at last, as if overcome by the potency of its fears, it jumps down from the tree directly into the throat of its frightful destroyer.

In order to ascertain the truth of this story, a mouse was put into a large iron cage, where a rattle-snake was kept, and the effect carefully observed. The mouse remained motionless at one end of the cage ; while the snake, at the other, continued fixed, with its eye glaring full on the little animal, and its jaws opened to their widest extent: the mouse, for some time, seemed eager to escape ; but every effort only served to increase its terrors, and to draw it still nearer the enemy ; till, after several ineffectual attempts to break the fascination, it was seen to run into the jaws of the rattle-snake, where it was instantly killed.

To these accounts, the incredulous oppose the improbability of the fact ; they assert, that such a power ascribed to serpents, is only the remnant of a vulgar error, by which it was supposed that serpents could be charmed, and had also a power of charming. They aver, that animals are so far from running down the throat of a rattle-snake in captivity, that the snake will eat nothing in that state, but actually dies for want of subsistence.

A serpent, called the whip-snake, is still more venomous than the former. This animal, which is a native of the east, is about five feet long, yet not much thicker than the thong of a coachman's whip. It is exceedingly venomous, and its bite is said to kill in about six hours. One of the Jesuit missionaries happening to enter into an Indian pagoda, saw what he took to be a whip-cord lying on the floor, and stooped to take it up ; but, upon handling it, what was his surprize, to find that it was animated, and no other than the whip-snake, of which he had heard such formidable accounts : fortune,

however, seemed favourable to him, for he grasped it by the head, so that it had no power to bite him, and only twisted its folds up his arm. In this manner he held it, till it was killed by those who came to his assistance.

To this formidable class might be added the asp, whose bite however is not attended with those drowsy symptoms which the ancients ascribed to it. The jaculus of Jamaica also, is one of the swiftest of the serpent kind. The hæmorrhoids, so called from the hæmorrhages, which its bite is said to produce; the seps, whose wound is very venomous, and causes the part affected to corrupt, in a very short time; the coral serpent, which is red, and whose bite is said to be fatal. But of all others, the cobra di capello, or hooded serpent, inflicts the most deadly and incurable wounds. Of this formidable creature there are five or six different kinds; but they are all equally dangerous, and their bite followed by speedy and certain death. It is from three to eight feet long, with two large fangs hanging out of the upper jaw. It has a broad neck, and a mark of dark brown on the forehead; which, when viewed frontwise, looks like a pair of spectacles; but behind, like the head of a cat. The eyes are fierce, and full of fire; the head is small and the nose flat, though covered with very large scales, of a yellowish ash-colour; the skin is white; and the large tumour on the neck is flat, and covered with oblong, smooth scales. The bite of this animal is said to be incurable, the patient dying in about an hour after the wound; the whole frame being dissolved into one putrid mass of corruption.

To remedy the bite of all these animals, perhaps sallad-oil would be very efficacious: however, the Indians make use of a composition, which is called, in Europe, petro de cobra, or the serpent stone; and which, applied to the wound, is said to draw out the venom. The composition of this stone, for it is an artificial substance, is kept a secret; and perhaps its effects in extracting the venom may be imaginary: nevertheless, it is certain that it has a power of sticking to the skin,

and sucking a part of the blood from the wound. This it may do somewhat in the same manner as we see a tobacco-pipe stick to the lips of a man who is smoking : yet still we are ignorant of the manner ; and the secret might probably be of some use in medicine. It were to be wished, therefore, that those who go into India would examine into this composition, and give us the result of their enquiries ; but I fear that it is not to benefit mankind, that our travellers now go to India.

C H A P. X.

Of Serpents without Venom.

THE class of serpents without poison, may be distinguished from those that are venomous, by their wanting the fang teeth : their heads also are not so thick in proportion to their bodies ; and, in general, they taper off to the tail more gradually in a point. But notwithstanding their being destitute of venom, they do not cease to be formidable : some grow to a size by which they become the most powerful animals of the forest ; and even the smallest and most harmless of this slender tribe, find protection from the similitude of their form.

The fangs make the great distinction among serpents ; and all this tribe are without them. Their teeth are short, numerous, and in the smaller kinds, perfectly inoffensive : they lie in either jaw, as in frogs and fishes, their points bending backwards, the better to secure their prey. They want that artificial mechanism by which the poisonous tribe inflict such deadly wounds : they have no gland in the head for preparing venom ; no conduits for conveying it to the teeth ; no receptacles there ; no hollow in the instrument that inflicts

the wound. Their bite, when the teeth happen to be large enough to penetrate the skin, for in general they are too small for this purpose, is attended with no other symptoms than those of an ordinary puncture; and many of this tribe, as if sensible of their own impotence, cannot be provoked to bite, though never-so rudely assaulted. They hiss, dart out their forky tongues, erect themselves on the tail, and call up all their terrors to intimidate their aggressors; but seem to consider their teeth as unnecessary instruments of defence, and never attempt to use them. Even among the largest of this kind, the teeth are never employed in the most desperate engagements. When a hare or a bird is caught, the teeth may serve to prevent such small game from escaping; but when a buffalo or a tiger is to be encountered, it is by the strong folds of the body, by the fierce verberations of the tail, that the enemy is destroyed: by this twining round, and drawing the knot with convulsive energy, this enormous reptile breaks every bone in the quadruped's body, and then, at one morsel, devours its prey.

From hence we may distinguish the unvenomous tribe into two kinds: first, into those which are seldom found of any considerable magnitude, and that never offend animals larger or more powerful than themselves, but which find their chief protection in flight or in the doubtfulness of their form; secondly, into such as grow to an enormous size, fear no enemy, but indiscriminately attack all other animals and devour them. Of the first kind is the common black snake, the blind worm, the esculapian serpent, the amphisbæna, and several others. Of the second, the liboya, the boiguacu, the depona, and the boiquatrara.

The black snake is the largest of English serpents, sometimes exceeding four feet in length. The neck is slender; the middle of the body thick; the back and sides covered with small scales; the belly with oblong, narrow, transverse plates: the colour of the back and sides are of a dusky brown; the middle of the back marked with two rows of small black spots, running from the head to the tail; the plates on the

belly are dusky ; the scales on the sides are of a bluish white : the teeth are small and serrated, lying on each side of the jaw in two rows. The whole species is perfectly inoffensive ; taking shelter in dung-hills, and among bushes in moist places ; from whence they seldom remove, unless in the midst of the day, in summer, when they are called out by the heat to bask themselves in the sun. If disturbed or attacked, they move away among the brambles with great swiftness ; but if too closely pursued, they hiss and threaten, and thus render themselves formidable, though incapable of offending.

The black snake preys upon frogs, insects, worms, mice, and young birds ; and considering the smallness of the neck, it is amazing how large an animal it will swallow. The black snake of Virginia, which is larger than our's, and generally grows to six feet long, takes a prey proportionable to its size, partridges, chickens, and young ducks. It is generally found in the neighbourhood of the hen-roost, and will devour the eggs even while the hen is sitting upon them : these it swallows whole ; and often, after it has done the mischief, will coil itself round in the nest.

The whole of this tribe are oviparous, excluding eighty or a hundred eggs at a time, which are laid in dung-hills or hot-beds ; the heat of which, aided by that of the sun, brings them to maturity. During winter they lie torpid, in banks of hedges, and under old trees.

The blind worm is another harmless reptile, with a formidable appearance. The usual length of the species is eleven inches. The eyes are red, the head is small ; the neck still more slender : from that part the body grows suddenly, and continues of an equal bulk to the tail, which ends quite blunt : the colour of the back is cinereous, marked with very small lines, composed of minute black specks ; the sides are of a reddish cast ; the belly dusky, and marked like the back. The motion of this serpent is slow ; from which, and from the smallness of the eyes, are derived its names ; some calling it the slow, and some the blind worm. Like all the rest of the

kind in our climates, they lie torpid during winter ; and are sometimes found, in vast numbers, twisted together. This animal, like the former, is perfectly innocent ; however, like the viper, it brings forth its young alive. Gefner tells us, that one of these being struck on the head when it was pregnant, it immediately cast forth its young.

The amphibæna, or the double-headed serpent, is remarkable for moving along with either the head or the tail foremost ; and from thence it has been thought to have two heads. This error took its rise from the thickness of the tail, which at a distance, may be mistaken for another head. Upon a nearer view, however, the error is easily discovered, and the animal will be found formed according to the usual course of nature. It is as thick at one end as at the other ; and the colour of the skin is like that of the earth, being rough, hard, and variously spotted. Some have affirmed that its bite is dangerous ; but this must be a mistake, as it wants the fangs, and consequently the elaboratory that prepares the poison.

These animals are only formidable from their similitude to the viper tribe ; and, in some countries, where such reptiles are common, they make the distinction so exactly, that while they destroy serpents of one kind with great animosity, they take others into their houses, and even into their bosoms, with a kind of unaccountable affection. The esculapian serpent of Italy is among this number. It is there suffered to crawl about the chambers ; and often gets into the beds where people lie. It is a yellow serpent, of about an ell long ; and though innocent, yet will bite when exasperated. They are said to be great destroyers of mice ; and this may be the reason why they are taken under human protection. The boyuna of Ceylon is equally a favourite among the natives ; and they consider the meeting it as a sign of good luck. The Surinam serpent, which some improperly call the ammodytes, is equally harmless and desirable among the savages of that part of the world. They consider themselves as extremely happy if this animal comes into their huts. The colours of this serpent are so many and

beautiful, that they surpass all description ; and these perhaps are the chief inducements to the savages to consider its visits as so very fortunate. A still greater favourite is the prince of serpents, a native of Japan, that has not its equal for beauty. The scales which cover the back are reddish, finely shaded, and marbled with large spots of irregular figures mixed with black. The fore-part of the head is covered with large beautiful scales, the jaws bordered with yellow, the fore-head marked with a black marble streak, and the eyes handsome and lively. But of all others, the gerenda of the East-Indies is the most honored and esteemed. To this animal, which is finely spotted with various colours, the natives of Calicut pay divine honors ; and while their deity lies coiled up, which is its usual posture, the people fall upon their faces before it with stupid adoration. The African gerenda is larger, and worshipped in the same manner, by the inhabitants of the coasts of Mozambique. The skin is not so finely spotted as the former ; but it is variegated all over the body with very fine white, ash-coloured, and black spots. The brilliancy of colouring, in these reptiles, would only serve with us to increase our disgust ; but in those countries where they are, common distinctions are made ; and even in this horrid class, there are some eyes that can discover beauty.

But in the larger tribe of serpents, there is nothing but danger to be apprehended. This formidable class, though without venom, have something frightful in their colour, as well as their size and form. They want that vivid hue with which the savages are so much pleased in the lesser kinds ; they are all found of a dusky colour, with large teeth, which are more formidable than dangerous.

The first of this class, is the great jiboya of Java and Brazil, which Legaut affirms, he has seen fifty feet long. Nor is he singular in this report, as many of the missionaries affirm the same ; and we have the concurrent testimony of historians as a further proof. The largest animal of this kind, which has been brought into Europe, is but thirty-six feet long ; and

it is probable, that much greater have been seen and destroyed before they were thought worth sending so far to satisfy European curiosity. The most usual length, however, of the jiboya, is about twenty feet, and the thickness in proportion. The teeth are small in proportion to the body ; nor are they used, but when it seizes the smallest prey. It lies in wait for wild animals near the paths, and when it throws itself upon them, it wraps them round so closely as to break all the bones; then moistening the whole body over with its flaver, it makes it fit for deglutition, and swallows it whole.

The boiguacu is supposed to be the next in magnitude, and has often been seen to swallow a goat whole. It is thickest in the middle of the body, and grows shorter and smaller towards the head and the tail ; on the middle of the back, there is a chain of small black spots running along the length of it ; and on each side, there are large round black spots, at some distance from each other, which are white in the centre: between these, near the belly, there are two rows of lesser black spots, which run parallel to the back. It has a double row of sharp teeth in each jaw, of a white colour, and shining like mother-of pearl. The head is broad ; and over the eyes it is raised into two prominences : near the extremity of the tail, there are two claws, resembling those of birds.

These serpents lie hid in the thickets, from whence they suddenly out unawares, and raising themselves upright on their tails, will attack both men and beasts. They make a loud hissing noise when exasperated ; and sometimes winding up trees, will dart down upon travellers, and twist themselves so closely round their bodies, as to dispatch them in a very few minutes. Condamine, however, affirms, that their bite is not dangerous ; for though the teeth are so large as to inspire the beholder with terror, yet the wound they make is attended with no dangerous consequences whatever. Dellon affirms, that they generally haunt desert places ; and though they are sometimes seen near great towns, or on the banks of rivers, yet it is generally after some great inundation: he never

saw any but what were dead ; and they appeared to him, like the trunk of a great tree lying on the ground.

To this class of large serpents, we may refer the *depona*, a native of Mexico, with a very large head and great jaws. The mouth is armed with cutting, crooked teeth, among which there are two longer than the rest, placed in the fore-part of the upper jaw, but very different from the fangs of the viper. All round the mouth there is a broad scaly border ; and the eyes are so large, that they give it a very terrible aspect. The fore-head is covered with very large scales ; on which are placed others, that are smaller, curiously ranged : those on the back are greyish, and along it runs a double chain, whose ends are joined in the manner of a buckler. Each side of the belly is marbled with large square spots, of a chefnut colour ; in the middle of which is a spot, which is round and yellow. They avoid the sight of man ; and consequently, never do much harm.

Such are the most noted animals of the serpent tribe ; but to recount all, would be a vain, as well as a useless endeavour. In those countries where they abound, their discriminations are so numerous, and their colours so various, that every thicket seems to produce a new animal. The same serpent is often found to bring forth animals of eight or ten different colours : and the naturalist, who attempts to arrange them by that mark, will find that he has made distinctions, which are entirely disowned by nature : however, a very considerable number might be added to enlarge the catalogue : but having supplied a general history, the mind turns away from a subject where every object presents something formidable or loathsome to the imagination. Indeed, the whole tribe resemble each other so nearly, that the history of one may almost serve for every other. They are all terrible to the imagination, all frightful to behold in their fury, and have long been considered as a race of animals, between whom and man there is a natural antipathy.

A N
H I S T O R Y
O F
I N S E C T S.

C H A P. I.

Of Insects in General.

HAVING gone through the upper ranks of nature, we descend to that of insects, a subject almost inexhaustible from the number of its tribes and the variety of their appearance. Those who have professedly written on this subject, seem to consider it as one of the greatest that can occupy the human mind, as the most pleasing in animated nature. "After an attentive examination," says Swammerdam, "of the nature and anatomy of the smallest as well as the largest animals, I cannot help allowing the least, an equal, or perhaps a superior degree of dignity. If, while we dissect with care the larger animals, we are filled with wonder at the elegant disposition of their parts, to what a height is our astonishment raised, when we discover all these parts arranged in the least in the same regular manner ! Notwithstanding the smallness of ants, nothing hinders our preferring them to the largest animals. If we consider either their unwearied diligence, their wonderful strength, or their inimitable propensity to labour. Their amazing love to their young is still more un-

paralleled among the larger classes. They not only daily carry them to such places as may afford them food ; but if, by accident, they are killed, and even cut into pieces, they, with the utmost tenderness, will carry them away piecemeal in their arms. Who can show such an example among the larger animals, which are dignified with the title of perfect ? Who can find an instance in any other creature that can come in competition with this ?”

Such is the language of a man, who, by long study, became enamoured of his subject ; but to those who judge less partially, it will be found, that the insect tribe, for every reason, deserve but the last and lowest rank in animated nature. As in mechanics, the most complicated machines are required to perform the nicest operations, so in anatomy, the noblest animals are most variously and wonderfully made. Of all living beings, man offers the most wonderful variety in his internal conformation ; quadrupeds come next ; and other animals follow in proportion to their powers or their excellencies. Insects seem, of all others, the most imperfectly formed : from their minuteness, the dissecting knife can go but a short way in the investigation ; but one thing argues an evident imperfection, which is, that many of them can live a long time, though deprived of those organs which are necessary to life in the higher ranks of nature. Many of them are furnished with lungs and a heart like nobler animals ; yet the caterpillar continues to live, though its heart and lungs, which is often the case, are entirely eaten away.

But it is not from their conformation alone that insects are inferior to other animals, but from their instincts also. It is true, that the ant and the bee present us with very striking instances of assiduity ; but how far are theirs beneath the marks of sagacity exhibited in the hound or the stag ! A bee taken from the swarm is totally helpless and inactive, incapable of giving the smallest variation to its instincts : it has but one single method of operating, and, if put from that, it can turn to no other. In the pursuits of the hound, there is something like a choice ;

in the labours of the bee, the whole appears like necessity or compulsion.

If insects be considered as bearing a relation to man; and as assisting him in the pleasures or necessities of life, they will, even in this respect, sink in the comparison with the larger tribes of nature. It is true, that the bee, the silk-worm, the cochineal fly, and the cantharides, render him signal services; but how many others of this class, are either noxious, or totally unserviceable to him! Even in a country like ours, where all the noxious animals have been reduced by repeated assiduity, the insect tribes still maintain their ground, and are but too often unwelcome intruders upon the fruits of human industry. But, in more uncultivated regions, their annoyance and devastations are terrible. What an uncomfortable life must the natives lead in Lapland, and some parts of America, where, if a candle be lighted, the insects swarm in such abundance, as instantly to extinguish it with their numbers: where the inhabitants are obliged to smear their bodies and faces with tar, or some other composition, to protect them from the puncture of their minute enemies; where, though millions are destroyed, famished millions are still seen to succeed, and to make the torture endless!

Their amazing number is also an argument of their imperfection. It is a rule, that obtains through all nature, that the nobler animals are slowly produced, and that nature acts with a kind of dignified economy; but the meaner births are lavished in profusion, and thousands are brought forth merely to supply the necessities of the more favorite objects of creation. Of all other productions in nature, insects are the most numerous. Vegetables that cover the surface of the earth, bear no proportion to their multitudes; and though at first sight, herbs of the field seem to be the parts of organized nature, produced in the greatest abundance, yet, upon minuter inspection, we shall find every plant supporting a number of scarce perceptible creatures, that fill up the various stages of youth, vigour, and age, in the compass of a few days existence.

All other animals are capable of some degree of education ; their instincts may be suppressed or altered ; the dog may be taught to fetch and carry ; the bird to whistle a tune ; and the serpent to dance : but the insect has but one invariable method of operating ; no arts can turn it from its instincts ; and, indeed, its life is too short for instruction, as a single season often terminates its existence.

For these reasons, the insect tribe are deservedly placed in the lowest rank of animated nature ; and, in general, they seem more allied to the vegetables on which they feed, than to the nobler classes above them. Many of them are attached to one vegetable, often to a single leaf ; there they increase with the flourishing plant, and die as it decays ; a few days fill up the measure of their contemptible lives ; while the ends for which they were produced, or the pleasures they enjoyed, to us at least, are utterly unknown.

Yet while I am thus fixing the rank of a certain class of animals, it seems necessary to define the nature of those animals which are thus degraded. Definitions in general produce little knowledge ; but here, where the shades of nature are so intimately blended, some discrimination is necessary to prevent confusion. The smallness of the animal, for instance, does not constitute an insect ; for then, many of the lizard kind, which are not above two inches long, would come under this denomination ; and if the smaller lizards, why not the crocodile, which would be a terrible insect indeed ? In the same manner, smallness, with a slow creeping motion, does not constitute an insect ; for, though snails might be called insects with the same propriety, the whole tribe of sea shell-fish would then have equal pretensions, and a very troublesome innovation would be brought into our language, which is already formed. Excluding such animals, therefore, from the insect tribe, we may define insects to be *little animals without red blood, bones or cartilages, furnished with a trunk or else a mouth, opening lengthwise, with eyes which they are incapable of covering, and with lungs which have their openings on the sides.* This definition compre-

hends the whole class of insects, whether with or without wings, whether in their caterpillar or butter-fly state, whether produced in the ordinary method of generation between male and female, or from an animal that is itself both male and female, or from the same animal cut into several parts, and each part reproducing a perfect animal.

From hence it appears, that in this class of animals there are numerous distinctions, and that a general description will by no means serve for all. Almost every species has its own distinct history; and exhibits manners, appetites, and modes of propagation, peculiarly its own. In the larger ranks of existence, two animals that nearly resemble each other in form will be found to have a similar history; but here insects almost entirely alike will be often found perfectly dissimilar, as well in their manner of bringing forth and subsisting as in the changes which they undergo during their short lives. Thus, as this class is prolific beyond computation, so are its varieties multiplied beyond the power of description. The attempt to enumerate all the species of a fly or a moth, would be very fruitless; but to give an history of all would be utterly impracticable; so various are the appetites, the manners, and the lives of this humble class of beings, that every species requires its distinct history. An exact plan, therefore, of nature's operations in this minute set of creatures is not to be expected; and yet such a general picture may be given, as is sufficient to show the protection which providence affords its smallest as well as its largest productions, and to display that admirable circulation in nature, by which one set of living beings find subsistence from the destruction of another: and by which life is continued without a pause in every part of the creation.

Upon casting a slight view over the whole insect tribe, just when they are supposed to rouse from their state of annual torpidity, when they begin to feel the genial influence of spring, and again exhibit new life in every part of nature, their numbers and their varieties seem to exceed all powers of calculation, and they are indeed too great for description. When we look closer, however, we shall find some striking similitudes, either

in their propagation, their manners, or their form, that give us a hint for grouping several of them into one description, and thus enabling us to shorten the labour of a separate history for every species. Swammerdam, Reaumur, and Linnæus, have each attempted to abridge the task of description, by throwing a number of similar animals into distinct classes, and thus making one general history stand for all. I will avail myself of their labours; and uniting their general distinctions, throw the whole class of insects into four separate distributions, given under each, the history of every species that seems to me considerable enough to deserve our notice. Thus our labour will be shortened; and the very rank in which an insect is placed, will, in some measure, exhibit a considerable part of its history.

In our cursory inspection of the insect tribe, the first animals that offer themselves are those which want wings, that appear crawling about on every plant, and on every spot of earth we regard with any degree of attention. Of these, some never obtain wings at any period of their existence, but are destined to creep on the vegetable, or the spot of earth where they are stationed, for their whole lives. On the contrary, others are only candidates for a more happy situation; and only wait their growing wings, when they may be said to arrive at their state of full perfection.

Those that never have wings, but creep about till they die, may be considered as constituting the first class of insects. All these, the flea, and the wood-louse only excepted, are produced from an egg; and when once they break the shell, they never suffer any further change of form, but continue to grow larger till they die. Thus the louse or the spider are produced from an egg, never suffering any alteration when once they are excluded; but, like the chicken or the duck, remaining invariably the same, from their birth to their dissolution.

The second order of insects consists of such as have wings; but which, when produced from the egg, have those wings cased up in such a manner as not to appear. This casing up of the wing, however, does not prevent the animal's running,

leaping and moving with its natural celerity; but when the case bursts, and the wings have a power of expanding, all the animal's motions become more extensive, and the animal arrives at full perfection. Thus, the grasshopper, the dragon fly, and the earwig, have their wings at first bound down; but when the skin, that, like a pair of stays, kept them confined, bursts, they are then expanded, and the animal pursues the purposes for which it was produced.

The third order of insects is of the moth and butterfly kind. These all have four wings, each covered with a mealy substance of various colours, which, when handled, comes off upon the fingers; and, if examined by the microscope, will appear like scales, with which the wing is nicely embroidered all over. These insects also are produced in a manner peculiar to themselves. They are first hatched from an egg, from whence proceeds a caterpillar that eats, and often casts its skin; the caterpillar having divested itself for the last time, assumes a new covering, which is called a chrysalis, or the cone in the silk-worm, in which it continues hidden till it comes forth a perfect moth or butterfly.

The fourth order is of those winged insects which come from a worm instead of a caterpillar, and yet go through changes similar to those which moths and butterflies are seen to undergo. They are first excluded from the egg as a worm, and then become a chrysalis; in some, their wings and legs are seen; in others, the animal is quite detached from the cone in which it is concealed; but all at length break their prison, and come out perfect winged animals; some furnished with two wings and some with four. The wings of all these differ from those of the butterfly and moth kind, by not having the mealy scales which are ever found on the wings of the former. In this class we may place the numerous tribes of gnats, beetles, bees and flies.

To these I will add, as a fifth order, a numerous tribe lately discovered, to which naturalists have given the name of zoophytes. These do not go through the ordinary forms of gene-

ration, but may be propagated by dissection. Some of these, though cut into a hundred parts, still retain life in each, and are endued with such a vivacious principle, that every part will in a short time become a perfect animal. They seem a set of creatures placed between animals and vegetables, and make the shade that connects animated and insensible nature. To this class belong the polypus, the earth worm, and all the varieties of the sea-nettle.

Having thus given a general distribution of insects, I will proceed to describe each class in the order I have mentioned them; beginning with insects without wings, as they more nearly resemble the higher ranks of nature as well in their habits as their conformation.

C H A P. II.

Of Insects without Wings.

EVERY moment's observation furnishes us with instances of insects without wings; but the difficulty is to distinguish those which are condemned continually to lead reptile lives, from such as only wait the happy moment of transmutation. For this, nothing but a long and intimate acquaintance, will suffice; but, in general, all animals resembling the flea, the louse, the spider, the bug, the wood-louse, the water-louse, and the scorpion, never acquire wings, but are produced from the egg in that form which they never change afterwards.

If we consider this class as distinct from others, we shall find them in general longer lived than the rest, and often continuing their term beyond one season, which is the ordinary period of an insect's existence. They seem also less subject to the influence of the weather; and often endure the ri-

gours of winter without being numbed into torpidity. The whole race of moths, butterflies, bees, and flies, are rendered lifeless by the return of cold weather ; but we need not be told, that the louse, the flea, and many of these wingless creatures that seem formed to teize mankind, continue their painful depredations the whole year round.

They come to perfection in the egg, as was said before ; and it sometimes happens, that when the animal is interrupted in performing the offices of exclusion, the young ones burst the shell within the parent's body, and are thus brought forth alive. This not unfrequently happens with the wood-louse, and others of the kind, which are sometimes seen producing eggs, and sometimes young ones perfectly formed.

Though these creatures are perfect from the beginning, yet they are often, during their existence, seen to change their skin : this is a faculty which they possess in common with many of the higher ranks of animals, and which answers the same purposes.

However tender their skins may seem to our feel, yet, if compared to the animal's strength and size, they will be found to resemble a coat of mail, or, to talk more closely, the shell of a lobster. By this skin, these animals are defended from accidental injuries, and particularly from the attacks of each other. Within this they continue to grow, till their bodies become so large as to be imprisoned in their own covering, and then the shell bursts, but is quickly replaced by a new one.

Lastly, these animals are endued with a degree of strength, for their size, that at first might exceed credibility.—Had man an equal degree of strength, bulk for bulk, with a louse or flea, the history of Samson would be no longer miraculous.—A flea will draw a chain a hundred times heavier than itself ; and to compensate for this force, will eat ten times its own size of provision in a single day.



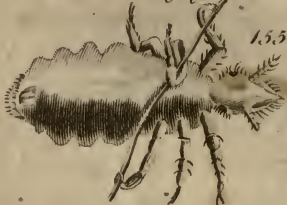
Scelopondra



Flea Magnified



Louse Magnified



Scorpions



Spiders



C H A P. III.

Of the Spider and its Varieties.

THE animal that deserves our first notice in this principal order of insects is the spider, whose manners are, of all others, the most subtle, and whose instincts are most various. Formed for a life of rapacity, and incapable of living upon any other than insect food, all its habits are calculated to deceive and surprize; it spreads toils to entangle its prey: it is endued with patience to expect its coming; and is possessed of arms and strength to destroy it when fallen into the snare.

In this country, where all the insect tribes are kept under by human assiduity, the spiders are but small and harmless. We are acquainted with few, but the house-spider, which weaves its web in neglected rooms; the garden-spider, that spreads its toils from tree to tree, and rests in the centre; the wandering-spider, that has no abode like the rest; and the field-spider, that is sometimes seen mounting, web and all, into the clouds. These are the chief of our native spiders; which, though reputed venomous, are entirely inoffensive. But they form a much more terrible tribe in Africa and America. In those regions, where all the insect species acquire their greatest growth, where the butterfly is seen to expand a wing as broad as our sparrow, and the ant to build a habitation as tall as a man, it is not to be wondered at, that the spiders are seen bearing a proportionable magnitude. In fact, the bottom of the Martinico spider's body is as large as a hen's egg, and covered all over with hair. Its web is strong, and its bite dangerous. It is happy for us, however, that we are placed at a distance from these formidable creatures, and that we can examine their history without feeling their resentment.

Every spider has two divisions in its body. The fore-part, containing the head and breast, is separated from the hinder

part or belly by a very slender thread, through which, however, there is communication from one part to the other. The fore-part is covered with a hard shell, as well as the legs, which adhere to the breast. The hinder part is clothed with a supple skin, beset all over with hair. They have several eyes all round the head, brilliant and acute; these are sometimes eight in number, sometimes but six; two behind, two before, and the rest on each side. Like all other insects, their eyes are immoveable; and they want eye-lids; but this organ is fortified with a transparent horny substance which at once secures and assists their vision. As the animal procures its subsistence by the most watchful attention, so large a number of eyes was necessary to give it the earliest information of the capture of its prey. They have two pincers on the fore-part of the head, rough, with strong points, toothed like a saw, and terminating in claws like those of a cat. A little below the point of the claw there is a small hole, through which the animal emits a poison, which, though harmless to us, is sufficiently capable of instantly destroying its prey. This is the most powerful weapon they have against their enemies; they can open or extend these pincers as occasion may require; and, when they are undisturbed, they suffer them to lie one upon the other, never opening them but when there is a necessity for their exertion. They have all eight legs, jointed like those of lobsters, and similar also in another respect; for if a leg be torn away, or a joint cut off, a new one will quickly grow in its place, and the animal will find itself fitted for combat as before. At the end of each leg there are three crooked moveable claws; namely, a small one, placed higher up, like a cock-spur, by the assistance of which it adheres to the threads of its web. There are two others larger, which meet together like a lobster's claw, by which they can catch hold of the smallest depressions, walking up or down the very polished surfaces, on which they can find inequalities that are imperceptible to our grosser sight. But, when they walk upon such bodies as are perfectly smooth, as looking-glass or polished marble, they squeeze a little sponge, which grows near

the extremity of their claws, and thus diffusing a glutinous substance, adhere to the surface until they make a second step. Besides the eight legs just mentioned, these animals have two others, which may more properly be called arms, as they do not serve to assist motion, but are used in holding and managing their prey.

The spider, though thus formidably equipped, would seldom prove successful in the capture, were it not equally furnished with other instruments to assist its depredations. As it lives wholly upon flies, and is without wings to pursue them, it is obvious they must forever escape so impotent an adversary; but the spider is a most experienced hunter, and spreads its nets to catch those animals it is unable to pursue. The spider's web is generally laid in those places where flies are most apt to come and shelter; in the corners of rooms, round the edges of windows, and in the open air among the branches of trees. There the little animal remains for days, nay weeks together, in patient expectation, seldom changing its situation, though never so unsuccessful.

For the purposes of making this web, nature has supplied this animal with a large quantity of glutinous matter, within its body, and five dugs or teats for spinning it into thread. This substance is contained in a little bag, and at first sight it resembles soft glue; but when examined more accurately, it will be found twisted into many coils of an agate colour, and, upon breaking it, the contents may be easily drawn out into threads, from the tenacity of the substance, not from those threads being already formed. Those who have seen the machine by which wire is spun, will have an idea of the manner in which this animal forms the threads of its little net, the orifices of the five teats above-mentioned, through which the thread is drawn, contracting or dilating at pleasure. The threads which we see, and appear so fine, are, notwithstanding, composed of five joined together, and these are many times doubled when the web is in formation.

When a house-spider proposes to begin a web, it first makes

choise of some commodious spot, where there is an appearance of plunder and security. The animal then distils one little drop of its glutinous liquor, which is very tenacious, and then creeping up the wall, and joining its thread as it proceeds, it darts itself in a very surprizing manner, as I have often seen, to the opposite place, where the other end of the web is to be fastened. The first thread thus formed, drawn tight, and fixed at each end, the spider then runs upon it backward and forward, still assiduously employed in doubling and strengthening it, as upon its force depends the strength and stability of the whole. The scaffolding thus completed, the spider makes a number of threads parallel to the first, in the same manner, and then crosses them with others; the clammy substance of which they are formed, serving to bind them, when newly made, to each other. The insect, after this operation, doubles and trebles the thread that borders its web, by opening all its teats at once, and secures the edges, so as to prevent the wind from blowing the work away. The edges being thus fortified, the retreat is next to be attended to; and this is formed like a funnel at the bottom of the web, where the little creature lies concealed. To this are two passages, or outlets, one above and the other below, very artfully contrived to give the animal an opportunity of making excursions at proper seasons, of prying into every corner, and cleaning those parts which are observed to be clogged or encumbered. Still attentive to its web, the spider, from time to time, cleans away the dust that gathers round it, which might otherwise clog and incommode it: for this purpose, it gives the whole a shake with its paws; still, however, proportioning the blow so as not to endanger the fabric. It often happens also, that from the main web, there are several threads extended at some distance on every side: these are, in some measure, the outworks of the fortification, which, whenever touched from without, the spider prepares for attack or self-defence. If the insect impinging be a fly, it springs forward with great agility; if, on the contrary, it be the assault of an enemy stronger than itself, it keeps within its fortrefs, and never ventures out till the dan-

ger be over. Another advantage which the spider reaps from this contrivance of a cell or retreat behind the web, is, that it serves for a place where the creature can feast upon its game with all safety, and conceal the fragments of those carcases which it has picked, without exposing to public view the least trace of barbarity, that might create a suspicion in any insects that their enemy was near.

It often happens, however, that the wind, or the rustling of the branches, or the approach of some large animal, destroys in a minute the labours of an age. In this case, the spider is obliged to remain a patient spectator of the universal ruin; and when the danger is passed away, it sets about repairing the calamity. For this purpose, it is furnished with a large store of the glutinous substance of which the web is made; and with this, it either makes a new web, or patches up the old one. In general, however, the animal is much fonder of mending than making, as it is furnished originally with but a certain quantity of glutinous matter, which, when exhausted, nothing can renew. The time seldom fails to come, when their reservoirs are entirely dried up, and the poor animal is left to all the chances of irretrievable necessity. An old spider is thus frequently reduced to the greatest extremity; its web is destroyed, and it wants the materials to make a new one. But as these animals have been long accustomed to a life of shifting, it hunts about to find out the web of another spider, younger and weaker than itself, with whom it ventures a battle. The invader generally succeeds; the young one is driven out to make a new web, and the old one remains in quiet possession. If, however, the spider is unable to dispossess any other of its web, it then endeavours, for a while, to subsist upon accidental depredation; but in two or three months it inevitably dies of hunger.

The garden-spider seems to work in a different manner. The method with this insect is to spin a great quantity of thread, which floating in the air in various directions, happens, from its glutinous quality, at last to stick to some object near it, a lofty plant or the branch of a tree. The spider only wants to

have one end of the line fast, in order to secure and tighten the other. It accordingly draws the line when thus fixed, and then, by passing and repassing upon it, strengthens the thread in such a manner as to answer all its intentions. The first cord being thus stretched, the spider walks along a part of it, and there fastens another, and dropping from thence, fastens the thread to some solid body below, then climbs up again, and begins a third, which it fastens by the same contrivance. When three threads are thus fixed, it forms a square, or something that very nearly resembles one; and in this the animal is generally seen to reside. It often happens, however, when the young spider begins spinning, that its web becomes too buoyant, and not only the thread floats in the air, but even the little spinster. In this manner we have often seen the threads of spiders floating in the air; and what is still more surprizing, the young spiders themselves attached to their own web. The reason is obvious; for as even gold itself may be so finely drawn out as to float in the air, so the finer thread of a spider is so buoyant, as not only to swim in the air, but also to lift the spider itself; which, like the tail of a kite, rises with its own manufacture.

The spider's web being thus completed, and fixed in a proper place, its next care is to seize and secure whatever insect happens to be caught in the toil. For this purpose, it remains for weeks and even months upon the watch, without ever catching a single fly; for the spider, like most other insects, is surprizingly patient of hunger. It sometimes happens that too strong a fly strikes itself against the web, and thus, instead of being caught, tears the net to pieces. In general, however, the butterfly or the hornet, when they touch the web, fly off again, and the spider seems no way disposed to interrupt their retreat. The large blue-bottle-fly, the ichneumon-fly, and the common meat-fly, seem to be its favourite game. When one of these strike into the toils, the spider is instantly seen alert and watchful at the mouth of its hole, careful to observe whether the fly be completely immeshed. If that be the case, the spider walks leisurely forward, seizes its prey, and instantly kills it by instilling a venomous juice into the wound it makes. If, however,

the fly be not entirely immeshed, the spider patiently waits, without appearing, until its prey has fatigued itself by its struggles to obtain its liberty; for if the ravager should appear in all his terrors, while the prey is but half involved, a desperate effort might give it force enough to get free. If the spider has fasted for a long time, it then drags the fly immediately into its hole and devours it; but if there has been plenty of game, and the animal be no way pressed by hunger, it then gives the fly two or three turns in its web, so as completely to immesh it, and there leaves it impotently to struggle until the little tyrant comes to its appetite. Why the spider should at one time kill its prey, and at another suffer it to struggle in the toils for several hours together, I am not able to say; perhaps it only likes its prey newly killed, and therefore delays to put the captive to death until it is to be eaten.

It has been the opinion of some philosophers, that the spider was in itself both male and female; but Lister has been able to distinguish the sexes, and to perceive that the males were much less in size than the females. But this is not the chief peculiarity; for, different from all other animals, except the fish called the ray, it has its instruments of generation placed in the fore-arms, which have been already described. When these animals copulate, they for some time teize each other with their legs and arms, then appear the instruments of generation in the male, as if bursting out from the points of its fore-feet, and are inserted into the receptacle beneath the body of the female.

The female generally lays from nine hundred to a thousand eggs in a season; they are of a bluish colour, speckled with black, and separated from each other by a glutinous substance, not unlike frog spawn water. These eggs are large or small in proportion to the size of the animal that produces them. In some they are as large as a grain of mustard-seed; in others, they are scarcely visible. The female never begins to lay till she be two years old at the least, and her first brood is never so numerous as when she has come to her greatest maturity.

When the number of eggs which the spider has brought

forth have remained for an hour or two, to dry after exclusion, the little animal then prepares to make them a bag, where they are to be hatched until they leave the shell. For this purpose, she spins a web four or five times stronger than that made for catching flies; and besides, lines it within side by a down, which she plucks from her own breast. This bag, when completed, is as thick as paper, is smooth within side, but rougher without. Within this they deposit their eggs; and it is almost incredible to relate the concern and industry which they bestow in the preservation of it. They stick it, by means of their glutinous fluid, to the end of their body; so that the animal, when thus loaded, appears as if she had one body placed behind another. If this bag be separated from her by any accident, she employs all her assiduity to stick it again in its former situation, and seldom abandons her treasure but with her life. When the young ones are excluded from their shells, within the bag, they remain for some time in their confinement, until the female, instinctively knowing their maturity, bites open their prison, and sets them free. But her parental care does not terminate with their exclusion; she receives them upon her back for some time, until they have strength to provide for themselves, when they leave her never to return, and each begins a separate manufactory of its own. The young ones begin to spin when they can scarcely be discerned; and prepare for a life of plunder before they have strength to overcome. Indeed, nature seems to have formed them in every respect for a life of hostility. No other insect is possessed of such various powers of assault and defence; and they are able to destroy animals ten times bigger than themselves. Even after a severe defeat, they quickly recover of their wounds; and as for their legs, they consider the loss of them as but a small misfortune, as they grow again very speedily to their former magnitude.

Thus there is no insect to which they are not an enemy; but what is more barbarous still, spiders are the enemies of each other. Mr. Reaumur, who was fond of making experiments upon insects, tried to turn the labours of the spider to

human advantage, and actually made a pair of gloves from their webs. For this purpose he collected a large number of those insects together : he took care to have them constantly supplied with flies, and the ends of young feathers, fresh picked from chickens and pigeons, which being full of blood, are a diet that spiders are particularly fond of. But notwithstanding all his care, he was soon convinced that it was impracticable to rear them, since they were of such a malignant nature, that they could never be brought to live in society ; but instead of their usual food, choose to devour each other. Indeed, were it practicable to reconcile them to each other, it would require too much attendance to rear up a sufficient number to make the project any way useful. Their thread is four, if not five times finer than that of the silk-worm ; so that, upon the smallest calculation, there must have been sixty thousand spiders to make a single pound of silk. That which Reaumur made use of, was only the web in which they deposited their eggs, which is five times stronger than their ordinary manufacture.

Of this animal there are several kinds, slightly differing from each other, either in habits or conformation. The water-spider is the most remarkable of the number. This insect resembles the common spider in its appearance, except that its hinder part is made rather in the shape of a nine-pin than a ball. They differ in being able to live as well by land as water ; and in being capable of spinning as well in one element as the other. Their appearance under water is very remarkable ; for though they inhabit the bottom, yet they are never touched by the element in which they reside, but are enclosed in a bubble of air, that, like a box, surrounds them on every side. This bubble has the bright appearance, at the bottom, of quicksilver ; and within this, they perform their several functions of eating, spinning and sleeping, without its ever bursting, or in the least disturbing their operations : sometimes, the bubble is seen divided into three distinct apartments ; and in the spring, the male enters one of those to impregnate the female, in the manner mentioned above, while the bubble in which he was contained unites with the other, like two drops of water, when ap-

proached to each other. They spin their webs as well in the water as upon land; and it is most probable that they make their food of the small insects of either element.

The tarantula is also of this species, and deserves particular notice, not for any remarkable properties that really attend it, but for the numerous falsehoods which have been propagated concerning it. What may be said with truth concerning it, is, that it is the largest of the spider kind known in Europe, and is a native of Apulia in Italy. Its body is three-quarters of an inch long, and about as thick as one's little finger; the colour is generally an olive brown, variegated with one that is more dusky; it has eight legs and eight eyes, like the rest, and nippers, which are sharp and ferrated: between these and the fore-legs, there are two little horns, or feelers, which it is observed to move very briskly when it approaches its prey. It is covered all over the body with a soft down; and propagates as other spiders, by laying eggs. In the summer months, particularly in the dog days, the tarantula creeping among the corn, bites the mowers and passengers: but in winter it lurks in holes, and is seldom seen.

Thus far is true; but now the fable begins: for though the bite is attended with no dangerous symptoms, and will easily cure of itself, wonderful stories are reported concerning its virulence. The part which is bitten, as we are told, is soon after discoloured with a livid black, or yellowish circle, attended with an inflammation. At first the pain is scarcely felt; but a few hours after, come on a violent sickness, difficulty of breathing, fainting, and sometimes trembling. The person bit, after this, does nothing but laugh, dance and skip about, putting himself into the most extravagant postures; and sometimes also is seized with a most frightful melancholy. At the return of the season in which he was bit, his madness begins again; and the patient always talks of the same things. Sometimes he fancies himself a shepherd; sometimes a king; appearing entirely out of his senses. These troublesome symptoms sometimes return for several years successively, and at last terminate in

death. But so dreadful a disorder has, it seems, not been left without a remedy ; which is no other than a well-played fiddle. For this purpose the medical musician plays a particular tune, famous for the cure ; which he begins slow, and increases in quickness as he sees the patient affected. The patient no sooner hears the music, but he begins to dance ; and continues so doing till he is all over in a sweat, which forces out the venom that appeared so dangerous. This dancing sometimes continues for three or four hours, before the patient is weary, and before the sweating is copious enough to cure the disorder. Such are the symptoms related of the tarantula poison ; symptoms which some of the best and gravest physicians have credited, and attempted to account for. But the truth is, that the whole is an imposition of the peasants upon travellers, who happen to pass through that part of the country, and who procure a trifle for suffering themselves to be bitten by the tarantula. Whenever they find a traveller willing to try the experiment, they readily offer themselves ; and are sure to counterfeit the whole train of symptoms which music is supposed to remove. A friend of mine, who passed through that part of the country, had a trusty servant bitten, without ever administering the musical cure : the only symptoms were a slight inflammation, which was readily removed, and no other consequence ever attended the bite.—It is thus that falsehoods prevail from a century or two ; and mankind at last begin to wonder how it was possible to keep up the delusion so long.

C H A P. IV.

Of the Flea.

THE history of those animals with which we are the best acquainted, are the first objects of our chiefest curiosity. There are few but are well informed of the agility and the blood-thirsty disposition of the flea; of the caution with which it comes to the attack; and the readiness with which it avoids the pursuit. This insect, which is not only the enemy of mankind, but of the dog, cat, and several other animals, is found in every part of the world, but bites with greater severity in some countries than in others. Its numbers in Italy and France are much greater than in England, and yet its bite is much more troublesome here, than I have found it in any other place. It would seem that its force increased with the coldness of the climate: and though less prolific, that it became more predaceous.

If the flea be examined with a microscope, it will be observed to have a small head, large eyes and a roundish body. It has two feelers or horns, which are short, and composed of four joints; and between these lies its trunk, which it buries in the skin, and through which it sucks the blood in large quantities. The body appears to be all over curiously adorned with a suit of polished sable armour, neatly jointed, and beset with multitudes of sharp pins, almost like the quills of a porcupine. It has six legs, the joints of which are so adapted, that it can, as it were, fold them up one within another; and when it leaps, they all spring out at once, whereby its whole strength is exerted, and the body raised above two hundred times its own diameter.

The young fleas are at first a sort of nits or eggs, which are round and smooth: and from these proceed white worms, of a shining pearl colour; in a fortnight's time they come to a tolerable size, and are very lively and active; but if they are touched at this time, they roll themselves up in a ball: soon af-

ter this they begin to creep, like silk-worms that have no legs ; and then they seek a place to lie hid in, where they spin a silken thread from their mouth, and with this they enclose themselves in a small round bag or case, as white within as writing paper, but dirty without : in this they continue for a fortnight longer ; after which they burst from their confinement perfectly formed, and armed with powers to disturb the peace of an emperor,

C H A P. V.

Of the Louse and its Varieties.

THE antipathies of mankind are various ; some considering the toad, some the serpent, some the spider, and some the beetle, with a strong degree of detestation : but while all wonder at the strangeness of each other's aversions, they all seem to unite in their dislike to the louse, and regard it as their natural and most nauseous enemy. Indeed, it seems the enemy of man in the most odious degree ; for wherever wretchedness, disease, or hunger seize upon him, the louse seldom fails to add itself to the tribe, and to increase in proportion to the number of his calamities.

In examining the human louse with the microscope, its external deformity first strikes us with disgust : the shape of the fore-part of the head is somewhat oblong ; that of the hind-part somewhat round : the skin is hard, and being stretched, transparent, with here and there several bristly hairs : in the fore-part is a proboscis or sucker, which is seldom visible : on each side of the head are antennæ, or horns, each divided into five joints, covered with bristly hair, and several white vessels are seen through these horns ; behind these are the eyes, which seem to want those divisions observable in other insects, and appear encompassed with some few hairs : the neck is very

short, and the breast is divided into three parts ; on each side of which are placed six legs, consisting of six joints, covered also with bristly hairs : the ends of the legs are armed with two smaller and larger ruddy claws, serving those insects as a finger and thumb, by which they catch hold of such objects as they approach : the end of the body terminates in a cloven tail, while the sides are all over hairy ; the whole resembling clear parchment, and, when roughly pressed, cracking with a noise.

When we take a closer view, its white veins and other internal parts appear ; as likewise a most wonderful motion in its intestines, from the transparency of its external covering. When the louse feeds, the blood is seen to rush, like a torrent, into the stomach ; and its greediness is so great, that the excrements contained in the intestines are ejected at the same time, to make room for this new supply.

The louse has neither beak, teeth nor any kind of mouth, as doctor Hooke described it ; for the entrance into the gullet is absolutely closed. In the place of all these, it has a proboscis or trunk ; or, as it may be otherwise called, a pointed hollow sucker, with which it pierces the skin, and sucks the human blood, taking that for food only. The stomach is lodged partly in the breast and back ; but the greatest portion of it is in the abdomen. When swollen with blood, it appears of a dark brown colour, which is visible through the skin, and is either a faint red, or a full or bright brown, as the contents of the stomach are more or less changed. When it is empty, it is colourless ; but when filled, it is plainly discernible, and its motion seems very extraordinary. It then appears working with very strong agitations, and somewhat resembles an animal within an animal. Superficial observers are apt to take this for the pulsation of the heart ; but if the animal be observed when it is sucking, it will then be found that the food takes a direct passage from the trunk to the stomach, where the remainder of the old aliment will be seen mixing with the new, and agitated up and down on every side.

If this animal be kept from food two or three days, and then placed upon the back of the hand, or any soft part of the body,

It will immediately seek for food ; which it will the more readily find, if the hand be rubbed till it grows red. The animal then turns its head, which lies between the fore legs, to the skin, and diligently searches for some pore ; when found, it fixes the trunk therein ; and soon the microscope discovers the blood ascending through the head, in a very rapid, and even frightful stream. The louse has at that time sufficient appetite to feed in any posture ; it is then seen sucking with its head downward, and its tail elevated ; if, during this operation, the skin be drawn tight, the trunk is bound fast, and the animal is incapable of disengaging itself ; but it more frequently suffers from its gluttony, since it gorges to such a degree, that it is crushed to pieces by the slightest impression.

Whether lice are distinguished by the parts of generation into males and females, is not yet discovered : Swammerdam is inclined to think that they are hermaphrodites, having found an ovary in all those he examined ; and he dissected not less than forty-two. In one of these animals were found ten large eggs ; and forty-four smaller, that were not yet come to their full perfection.

There is scarce any animal that multiplies so fast as this unwelcome intruder. It has been pleasantly said, that a louse becomes a grandfather in the space of twenty-four hours : this fact cannot be ascertained ; but nothing is more true, than, that the moment the nit, which is no other than the egg of the louse, gets rid of its superfluous moisture, and throws off its shell, it then begins to breed in its turn. Nothing so much prevents the increase of this nauseous animal, as cold and want of humidity ; the nits must be laid in a place that is warm, and moderately moist, to produce any thing. This is the reason that many nits laid on the hairs in the night-time, are destroyed by the cold of the succeeding day ; and so stick for several months, till they at last come to lose even their external form.

The louse is found upon every part of the human body ; but particularly in the heads of children. Those found upon the miners in Sweden, are said, by Linnæus, to be very large ;

and he is of opinion, that the head and the body-louse differ in no respect from each other. The pthiriasis, or lousy disease, though very little known at present, was frequent enough among the ancients: Herod. Antiochus, Epiphanes, Alcman the poet, Pherecydes, Cassander, Callisthenes and Sylla, all died of this disorder. The use of mercury, which was unknown among the ancients, may probably have banished it from among the moderns; for certain it is, that those animals seldom attack any in our climate, but such as from sloth or famine invite their company.

Such is the history of the human louse; which, from its connexion with mankind, deserves first notice: but it would be endless to describe the various tribes that go under this name, and swarm upon every part of nature. There is scarce an animal, and scarce even a vegetable, that does not suffer under its own peculiar louse. The sheep, the horse, the hog, and the elephant, are all teized by them; the whale, the shark, the salmon, and the lobster, are not without their company; while every hot-house, and every garden is infested with some peculiarly destructive. Linnæus tells us, that he once found a vegetable-louse upon some plants newly arrived from America; and willing to trace the little animal through its various stages, he brought it with him from London to Leyden; where he carefully preserved it during the winter, until it bred in the spring: but the louse it seems did not treat him with all the gratitude he expected; for it became the parent of so numerous a progeny, that it soon over-run all the physic-garden of that beautiful city; and leaves, to this day, many a gardener to curse the Swede's too indulgent curiosity.

The animal which some have called the leaf-louse, is of the size of a flea, and of a bright green, or bluish green colour; the body is nearly oval, and is largest and most convex on the hinder part; the breast is very small, and the head is blunt and green: the eyes may be seen very plainly, being prominent on the fore-part of the head, and of a shining black colour; near-

These there is a black line on each side ; and the legs are very slender.

These animals are usually found upon the leaves of the orache, and other plants ; and the weaker the leaves and buds are, these insects swarm upon them in greater abundance. Some plants are covered over with them, though they are not the cause of the plant's weakness, but the sign : however, by wounding and sucking the leaf, they increase the disease. They generally assume their colour from the plant on which they reside. Those that feed upon pot-herbs and plum-trees, are of an ash-colour ; only they are greenish when they are young : those that belong to the alder and cherry-tree, are black ; as also those upon beans, and some other plants : those on the leaves of apples and rose-trees, are white : but as they leap, like grasshoppers, some place them in the number of the flea-kind. The most uncommon colour is reddish ; and lice of this sort may be found on the leaves of tansy ; and their juice, when rubbed in the hands, tinges them with no disagreeable red. All these live upon their respective plant ; and are often engendered within the very substance of the leaf.

All these bring forth their young alive ; and the fœtus, when it is ready to be brought forth, entirely fills the belly of the female ; its fore-parts being excluded first, and then the hinder. The young one does not begin to move till the horns or feelers appear out of the body of the old one ; and by the motion of these, it first shows signs of life, moving them in every direction, and bending all their joints. When the horns and head are excluded, the two fore-feet follow, which they move with equal agility ; after this follow the middle feet, and then the hinder : still, however, the young one continues sticking to its parent, supported only at one extremity, and hanging as it were in air, until its small and soft members become hardened and fitted for self-support. The parent then gets rid of its burthen ; by moving from the place where she was sitting, and forcing the young one to stand upon its legs, leaves it to shift for itself.

As the animal has not far to go, its provision lying beneath

it, during the summer it continues to eat and creep about with great agility. But as it is viviparous, and must necessarily lurk somewhere in winter, where its body may be defended from the cold, it endeavours to secure a retreat near the trees or plants that serve to nourish it in the beginning of spring. They never hide themselves in the earth, like many other insects, because they have no part of their bodies fitted to remove the earth; nor can they creep into every chink, as their legs are too long; besides their bodies are so tender, that the least rough particle of the earth would hurt them. They therefore get into the deep chinks of the bark, and into the cavities of the stronger stalks, from whence they fall out upon the branches and leaves, when the warmth of the sun begins to be felt. Neither the cold in the autumnal season, nor the lesser degree of heat in the spring, ever hurts them; they seldom, therefore, seek for hiding-places before the fall of the leaf, and are alert enough to take the earliest advantage of the returning spring.

Like many other insects, they cast their skins four several times; and, what is very remarkable, the males have four wings, but the females never have any. They all have long legs, not only to enable them to creep over the long hairs of plants and leaves, but also to travel from one tree to another, when they happen to stand at a distance. Their trunk or snout lies under their breast; and this they thrust into the pores of the plant to suck out the juice, for they do not gnaw them, like the caterpillar; but so hurt them by sucking, that the leaves become spotted, and, as it were, over-run with scabs; for which reason their edges always turn up towards the middle.

It has been said, that these insects are often carried away and devoured by ants; but this Frysch, from whom this description is taken, could never observe. The ants indeed are fond of those trees, where there is a great number of those insects; but then it is only to suck the juice which flows from the leaves that have been just wounded. This more particularly happens in the heat of summer, when other moisture is wanting; how-

over, he never found them hurting or carrying away any of these insects while alive; nor indeed were they able, for the leaf-louse is more than a match for the ant, at single combat. Whenever they perceive the ant approaching behind them, they kick back with their hinder feet, and thus drive off the invader, as a horse would a lion.

The three principal and constant enemies to these insects are, first, the fire-flie, which lays its eggs where these insects are in greatest number, which producing a worm, seizes and devours all the leaf lice that come near it; another enemy is the worm, of a peculiar kind of beetle, which destroys them in great numbers; but the most formidable of all enemies, is the ichneumon fly, that seizes upon one of the largest females, and laying its egg upon her, this is hatched into a worm, which soon devours and destroys the animal from whose body it sprung.

C H A P. VI.

Of the Bug and its Varieties.

THE bug is another of those nauseous insects that intrude upon the retreats of mankind; and that often banish that sleep, which even sorrow and anxiety permitted to approach. This, to many men, is, of all other insects, the most troublesome and obnoxious. The night is usually the season when the wretched have rest from their labour; but this seems the only season when the bug issues from its retreats, to make its depredations. By day it lurks, like a robber, in the most secret parts of the bed; takes the advantage of every chink and cranny to make a secure lodgment, and contrives its habitation with so much art, that scarce any industry can discover its retreat. It seems to avoid the light with great care, and even if candles be kept burning, this *scourge* will not issue from its hiding-place. *P*roviding it misestimates security, it then issues

drops from the tester, crawls from behind the arras, and travels with great assiduity to the unhappy patient, who vainly wishes for rest and refreshment. It is generally vain to destroy one only, as there are hundreds more to revenge their companion's fate; so that the person who thus is subject to be bitten, remains the whole night like a centinel upon duty, rather watching the approach of fresh invaders, than inviting the pleasing approaches of sleep.

Nor are these insects less disagreeable from their neuseous stench, than their unceasing appetites. When they begin to crawl, the whole bed is infected with the smell; but if they are accidentally killed, then it is insupportable.

These are a part of the inconveniencies that result from the persecution of these odious insects: but, happily for Great-Britain, they multiply less in these islands, than in any part of the continent. In France and Italy, the beds, particularly in their inns, swarm with them; and every piece of furniture seems to afford them a retreat. They grow larger also with them than with us, and bite with more cruel appetite.

This animal, if examined minutely, appears to consist of three principal parts; the head, the corselet, and the belly. It has two brown eyes, that are very small, and a little prominent, besides two feelers, with three joints; underneath these there is a crooked trunk, which is its instrument of torture, and which, when in motion, lies close upon the breast. The breast is a kind of ring, in which are placed the two first pair of legs. The belly consists of nine rings; under which are placed two pair of legs more, making six in all. Each leg has three joints, which form the thigh, the leg, and the foot, which is armed with a crooked claw, like a hook. The body is smooth, except a few short hairs, that may be seen by the microscope, about the vent, and on the two last rings. Its motion is slow and unwieldy; yet its sight is so exquisite, that the instant it perceives the light, it generally makes good its retreat; and they are seldom caught, though the bed swarms with them.

If we examine this insect internally, we shall find the great artery, which in all insects performs the functions of the heart; we shall find the apertures of the lungs on the right side and the left, through which the animal breathes; we shall find a stomach and intestines, which, as in other animals, run from the mouth to the anus. If the insect has been kept long fasting, there will be a mucus found in its body, like the white of an egg; but if crushed after a full meal, the human blood, which it has sucked in, will appear a little darkened, by having passed through the insect's body.

The male and female of these animals are plainly distinguishable from each other; and the parts of generation are obvious enough. They are often found coupling tail to tail; and in this state are very easily destroyed. The female has an ovary filled with eggs, joined together like a bunch of grapes; each egg being oblong, almost cylindrical, inclining to white, and pretty transparent. In about two days after impregnation by the male, she deposits her eggs to the number of about a hundred and fifty, in some convenient place, where they are likely to receive no disturbance. There they continue for some months; during which time, neither cold nor heat, neither moisture nor fumigation, can in the least retard their exclusion; but they come forth active, and ready for mischief. It is this hardiness in the shell that seems to continue the breed; as the old ones die every winter, or are easily destroyed by any fumigation that is used for that purpose. But the eggs seem incapable of destruction; even those men who make a livelihood by killing these nauseous insects, though they can answer for the parent, can never be sure of the egg. For this reason, they usually pay those houses to which they are called a second or a third visit, and at last exterminate them by perseverance.

The manner of destroying them seems rather the effects of assiduity than antidote; for the men called in upon this occasion, take every part of the furniture asunder, brush every part of it with great assiduity, anoint it with a liquid, which

I take to be a solution of corrosive sublimate; and having performed this operation twice or thrice, the vermin are most usually destroyed.

Cleanliness, therefore, seems to be the best antidote to remove these nauseous insects; and wherever that is wanting, their increase seems but a just punishment. Indeed, they are sometimes found in such numbers among old furniture, and neglected chambers, exposed to the south, that, wanting other sustenance, they devour each other. They are also enemies to other vermin, and destroy fleas very effectually; so that we seldom have the double persecution of different vermin in the same bed. Of the bug kind Linnæus reckons up forty.

C H A P. VII.

Of the Wood-Louse and its Varieties.

THE common wood-louse is seldom above half an inch long, and a quarter of an inch broad. The colour is of a livid black, especially when found about dung-hills, and on the ground; but those that are to be met with under tiles, and in drier places, are of the colour of the hair of an ass. It has fourteen feet, seven on each side; and they have only one joint each, which is scarcely perceivable. It has two short feelers, and the body is of an oval shape. When it is touched, it rolls itself up into a sort of a ball; and the sides, near the feet, are dentated, like a saw. It is often found among rotten timber, and on decayed trees: in winter it lies hid in the crevices of walls and all sorts of buildings. The male is easily distinguishable from the female, being less, and more slender. The eggs they lay are white and shining, like seed pearls, and are very numerous: however, more properly speaking, although, when excluded, the young have all the appearance of

an egg, yet they are alive, and, without throwing off any shell, stir and move about with great vivacity; so that this animal may properly be said to be viviparous. The little worms at first seem scarce able to stir; but they soon feed, and become very brisk. These animals are of great use in medicine; being impregnated with a saline quality, which is diuretic and stimulating. Of this insect, Linnæus makes three species.

C H A P. VIII.

Of the Monoculus; or, Arboresecent Water-Flea.

THIS animal, which is of the size of a flea, appears to the sight, unassisted by the microscope, to have but one eye; for the eyes, by reason of the smallness of the head, seem to be joined to each other: they are situated in the trunk of this insect: and the beak is likewise very small and sharp pointed. The structure of the eye is seen, by the microscope, to be reticulated, or made like a net; and the trunk of this insect, by which it feeds, is not only small and sharp, but also transparent. The insects are of a blood red colour; and sometimes are seen in such multitudes on the surface of standing water, as to make them appear all over red, whence many fanciful people have thought the water to be turned into blood.

Swammerdam tells us of a celebrated professor of Leyden, who was at first astonished by an appearance of this kind. Being once intent upon his studies, he heard a noise, of which, as it increased by degrees, he was desirous to know the cause. The maid-servant attending to his summons, appeared quite petrified with fear, and told him, with a tremulous voice, that all the waters of Leyden were turned into blood. Upon this, he went directly in a small bark to the place where the

water was thus changed, and put some of the bloody water into a glass; but, upon viewing it with attention, he observed, that it abounded with infinite numbers of these little red insects, which tinged the whole body of the fluid with that seemingly formidable colour. Thus, his sudden fright was changed into lasting admiration.

Of all parts of this animal, its branching arms, and the motion it makes with them in the water, deserve our greatest attention. By these the little creature can move in a straight line; waving its arms, as a bird does its wings in the air, sometimes upward, sometimes downward, sometimes to the right, sometimes to the left, yet still continuing to proceed in a right line. By striking the water with its arms, it can ascend with great velocity; and by striking in a contrary direction, it dives with equal ease. As these motions are very rapid, the little animal appears to jump in the water, its head always tending to the surface, and its tail stretched downward. This insect is produced from an egg, which, when excluded, is carried on the back of the female, and soon is seen floating in the water round her. Its appearance at first is that of a very small whitish insect, endued with a very nimble motion. Except in colour, it suffers no change, only continuing to grow larger and redder, as it grows old. They sometimes remain several days on the surface of the water; and sometimes are seen at the bottom only; but they are never at rest. They change their skin like most other insects; and the cast skin resembles the insect itself so exactly, that one might mistake the mask for the animal.

C H A P. IX.

Of the Scorpion and its Varieties.

THERE is scarce an insect without wings that is not obnoxious to man: the smallest have the power of annoying him, either by biting or stinging him; and though each is in itself contemptible, they become formidable from their numbers. But, of all this class, there is none so terrible as the scorpion, whose shape is hideous, whose size among the insect tribe is enormous, and whose sting is generally fatal. Happy for England, the scorpion is entirely a stranger among us! In several parts of the continent of Europe it is but two well known, though it seldom grows above four inches long: but in the warm tropical climates, it is seen a foot in length, and in every respect as large as a lobster.

The scorpion is one of the largest of the insect tribe, and not less terrible from its size than its malignity. It resembles a lobster somewhat in shape, but is infinitely more hideous. There have been enumerated nine different kinds of this dangerous insect, chiefly distinguished by their colour: there being scorpions yellow, brown, and ash-coloured; others that are the colour of rusty iron, green, pale yellow, black, claret colour, white, and grey.

There are four principal parts distinguishable in this animal; the head, the breast, the belly, and the tail. The scorpion's head seems, as it were, jointed to the breast; in the middle of which are seen two eyes; and a little more forward two eyes more, placed in the fore-part of the head: these eyes are so small, that they are scarcely perceivable; and it is probable the animal has but little occasion for seeing. The mouth is furnished with two jaws; the undermost is divided into two, and the parts notched into each other, which serves the animal as teeth, and with which it breaks its food, and

thrusts it into its mouth: these the scorpion can at pleasure pull back into its mouth, so that no part of them can be seen. On each side of the head are two arms, each composed of four joints; the last of which is large, with strong muscles, and made in the manner of a lobster's claw. Below the breast are eight articulated legs, each divided into six joints: the two hindmost of which are each provided with two crooked claws, and here and there covered with hair. The belly is divided into seven little rings; from the lowest of which is continued a tail, composed of six joints, which are bristly, and formed like little globes, the last being armed with a crooked sting. This is that fatal instrument which renders this insect so formidable: it is long, pointed, hard and hollow; it is pierced near the base by two small holes, through which, when the animal stings, it ejects a drop of poison, which is white, caustic, and fatal. The reservoir in which this poison is kept, is in a small bladder near the tail, into which the venom is distilled by a peculiar apparatus. If this bladder be gently pressed, the venom will be seen issuing out through the two holes above-mentioned; so that it appears, that when the animal stings, the bladder is pressed and the venom issues through the two apertures into the wound.

There are few animals more formidable, or more truly mischievous than the scorpion. As it takes refuge in a small place, and is generally found sheltering in houses, so it cannot be otherwise than that it must frequently sting those among whom it resides. In some of the towns of Italy, and in France, in the province of Languedoc, it is one of the greatest pests that torment mankind: but its malignity in Europe is trifling, when compared to what the natives of Africa, and the east, are known to experience. In Batavia, where they grow twelve inches long, there is no removing any piece of furniture, without the utmost danger of being stung by them. Bosman assures us, that, along the Gold Coast, they are often found larger than a lobster; and that their sting is inevitably fatal. In Europe, however, they are by no means so large, so venomous, or so plenty. The general size of this animal does not

exceed two or three inches ; and its sting is very seldom found to be fatal. Maupertuis, who made several experiments on the scorpion of Languedoc, found it by no means so invariably dangerous as had till then been represented. He provoked one of them to sting a dog, in three places of the belly, where the animal was without hair. In about an hour after the poor animal seemed greatly swollen, and became very sick : he then cast up whatever he had in his bowels ; and, for about three hours, continued vomiting a whitish liquid. The belly was always greatly swollen, when the animal began to vomit ; but this operation always seemed to abate the swelling ; which alternately swelled, and was thus emptied, for three hours successively. The poor animal, after this, fell into convulsions, bit the ground, dragged himself along upon his fore-feet, and at last died, five hours after being bitten. He was not partially swollen round the place which was bitten, as is usual after the sting of a wasp or a bee ; but his whole body was inflated, and there only appeared a red spot on the places where he had been stung.

Some days after, however, the same experiment was tried upon another dog, and even with more aggravated cruelty ; yet the dog seemed no way affected by the wounds, but howling a little when he received them, continued alert and well after them ; and soon after was set at liberty, without showing the smallest symptoms of pain. So far was this poor creature from being terrified at the experiment, that he left his own master's house to come to that of the philosopher, where he had received more plentiful entertainment. The same experiment was tried by fresh scorpions, upon seven other dogs, and upon three hens ; but not the smallest deadly symptom was seen to ensue. From hence it appears, that many circumstances, which are utterly unknown, must contribute to give efficacy to the scorpion's venom. Whether its food, long fasting, the season, the nature of the vessels it wounds, or its state of maturity, contribute to, or retard its malignity, is yet to be ascertained by succeeding experiment. In the trials made by our philosopher, he employed scorpions of both sexes, newly caught, and seemingly vigor-

ous and active. The success of this experiment may serve to show, that many of those boasted antidotes which are given for the cure of the scorpion's sting, owe their success rather to accident than their own efficacy. They only happened to cure, when their sting was no way dangerous; but in cases of actual malignity, they might probably be utterly unserviceable.

The scorpion of the tropical climates being much larger than the former, is probably much more venomous. Helbigius, however, who resided for many years in the east, assures us, that he was often stung by the scorpion, and never received any material injury from the wound: a painful tumour generally ensued; but he always cured it, by rubbing the part with a piece of iron or stone, as he had seen the Indians practise before him, until the flesh became insensible. Seba, Moore and Bosman, however, give a very different account of the scorpion's malignity; and assert, that unless speedily relieved, the wound becomes fatal.

It is certain, that no animal in the creation seems endued with such an irascible nature. I have often seen them taken and put into a place of security, exerting all their rage against the sides of the glass vessel that contained them. I have seen them attempt to sting a stick, when put near them; and attack a mouse or a frog, while those animals were far from offering any injury. Maupertuis put three scorpions and a mouse into the same vessel together, and they soon stung the little animal in different places. The mouse, thus assaulted, stood for some time upon the defensive, and at last killed them all, one after another. He tried this experiment, in order to see whether the mouse, after it had killed, would eat the scorpions; but the little quadruped seemed satisfied with victory, and even survived the severity of the wounds it had received. Wolkamer tried the courage of the scorpion against the large spider, and enclosed several of both kinds in glass vessels, for that purpose*. The success of this combat was very remarkable.

* Ephemerides. Dec. II. 1687. Observ. 224.

The spider at first used all its efforts to immesh the scorpion in its web, which it immediately began spinning; but the scorpion rescued itself from the danger, by flinging its adversary to death: it soon after cut off, with its claws, all the legs of the spider, and then sucked all the internal parts at its leisure.—If the scorpion's skin had not been so hard, Wolkamer is of opinion that the spider would have obtained the victory; for he had often seen one of these spiders destroy a toad.

The fierce spirit of this animal is equally dangerous to its own species; for scorpions are the cruellest enemies to each other. Maupertuis put about a hundred of them together in the same glass; and they scarce came into contact, when they began to exert all their rage in mutual destruction: there was nothing to be seen but one universal carnage, without any distinction of age or sex: so that, in a few days, there remained only fourteen, which had killed and devoured all the rest.

But their unnatural malignity is still more apparent, in their cruelty to their offspring. He enclosed a female scorpion, big with young, in a glass vessel, and she was seen to devour them as fast as they were excluded: there was but one only of the number that escaped the general destruction, by taking refuge on the back of its parent; and this soon after revenged the cause of its brethren, by killing the old one in its turn.

Such is the terrible and unrelenting nature of this insect, which neither the bonds of society, nor of nature can reclaim: it is even asserted, that, when driven to an extremity, the scorpion will often destroy itself. The following experiment was ineffectually tried by Maupertuis: but I am so well assured of it by many eye-witnesses, who have seen it both in Italy and America, that I have no doubt remaining of its veracity. A scorpion, newly caught, is placed in the midst of a circle of burning charcoal, and thus an egress prevented on every side: the scorpion, as I am assured, runs for about a minute round the circle, in hopes of escaping; but finding that impossible,

it stings itself on the back of the head, and in this manner the undaunted suicide instantly expires.

It is happy for mankind that these animals are thus destructive to each other; since otherwise they would multiply in so great a degree, as to render some countries uninhabitable. The male and female of this insect are very easily distinguishable; the male being smaller and less hairy. The female brings forth her young alive, and perfect in their kind. Rhedi having bought a quantity of scorpions, selected the females, which, by their size and roughness, were easily distinguishable from the rest, and putting them in separate glass vessels, he kept them for some days without food. In about five days one of them brought forth thirty-eight young ones, well shaped, and of a milk-white colour, which changed every day more and more into a dark rusty hue. Another female, in a different vessel, brought forth twenty-seven of the same colour; and the day following the young ones seemed all fixed to the back and belly of the female. For near a fortnight all these continued alive and well; but afterwards some of them died daily until, in about a month, they all died, except two.

Were it worth the trouble, these animals might be kept living as long as curiosity should think proper. Their chief food is worms and insects; and upon a proper supply of these, their lives might be lengthened to their natural extent. How long that may be we are not told; but if we may argue from analogy, it cannot be less than seven or eight years; and perhaps, in the larger kind, double that duration. As they have somewhat the form of the lobster, so they resemble that animal in casting their shell, or more properly their skin; since it is softer by far than the covering of the lobster, and set with hairs, which grow from it in great abundance, particularly at the joinings. The young lie in the womb of the parent, each covered up in its own membrane, to the number of forty or fifty, and united to each other by an oblong thread, so as to exhibit altogether the form of a chaplet.

Such is the manner in which the common scorpion pro-

duces its young, but there is a scorpion of America, produced from the egg, in the manner of the spider. The eggs are no larger than pin points; and they are deposited in a web, which they spin from their bodies, and carry about with them, till they are hatched. As soon as the young ones are excluded from the shell, they get upon the back of the parent, who turns her tail over them, and defends them with her sting. It seems probable, therefore, that captivity produces that unnatural disposition in the scorpion, which induces it to destroy its young; since, at liberty, it is found to protect them with such unceasing assiduity.

C H A P. X.

Of the Scolopendra and Gally-worm.

OF these hideous and angry insects we know little, except the figure and the noxious qualities. Though with us there are insects somewhat resembling them in form, we are placed at a happy distance from such as are really formidable. With us they seldom grow above an inch long; in the tropical climates they are often found above a quarter of a yard.

The scolopendra is otherwise called the centipes, from the number of its feet; and it is very common in many parts of the world, especially between the tropics. Those of the East-Indies, where they grow to the largest size, are about six inches long, of a ruddy colour, and as thick as a man's finger: they consist of many joints; and from each joint is a leg on each side; they are covered with hair, and seem to have no eyes; but there are two feelers on the head, which they make use of to find out the way they are to pass: the head is very round, with two small sharp teeth, with which they inflict wounds, that are very painful and dangerous. A sailor that was bit by one on

board a ship, felt an excessive pain, and his life was supposed to be in danger : however, he recovered, by the application of three roasted onions to the part ; and was soon quite well. Of this animal there are different kinds ; some living, like worms, in holes in the earth ; others under stones, and among rotten wood : so that nothing is more dangerous than removing those substances, in the places where they breed.

The gally-worm differs from the scolopendra, in having double the number of feet ; there being two on each side, to every joint of the body. Some of these are smooth, and others hairy ; some are yellow, some black, and some brown. They are found among decayed trees, between the wood and the bark ; as also among stones that are covered with moss. They all, when touched, contract themselves, rolling themselves up like a ball. Whatever may be their qualities in the tropical parts of the world, in Europe they are perfectly harmless ; having been often handled and irritated, without any vindictive consequences.

All these, as well as the scorpion, are supposed to be produced perfect from the parent, or the egg ; and to undergo no changes, after their first exclusion. They are seen of all sizes : and this is a sufficient inducement to suppose, that they preserve their first appearance, through the whole of their existence. It is probable, however, that, like most of this class, they often change their skins : but of this we have no certain information.

C H A P. XI.

Of the Leech.

THE last of this wingless tribe that I shall mention is the leech, which, like all the former, undergoes no varieties of transformation ; but when once excluded from the

body of the parent, preserves its first figure to the end. I place the history of the leech among the first class of insects; while I have degraded the earth-worm, the tænia and the polypus, into the class of zoophytes, or that imperfect tribe which serves to make the shade between animal and vegetable nature. Not but that the earth-worm, or the polypus have their motions, their appetites, and their vital principles, as complete as the leech, and, to a cursory view, appear every way as complete animals. But there is one circumstance that lays the line between them; that exalts the one and degrades the other. The earth-worm and the polypus may be cut into pieces, and each piece will produce a new and perfect animal: the leech cannot suffer this dissection, but dies when cut in two; an evident instance that it is possessed of a more perfect organization than those animals which it otherwise very much resembles.

The leech, from its uses in medicine, is one of those insects that man has taken care to provide; but of a great variety, one kind only is considered as serviceable. The horse-leech, which is the largest of all, and grows to four inches in length, with a glossy black surface, is of no use, as it will not stick to the skin; the snail-leech is but an inch in length; and though it will stick, is not large enough to extract a sufficient quantity of blood from the patient; the broad-tailed leech, which grows to an inch and a half in length, with the back raised into a sort of a ridge, will stick but on very few occasions: it is the large brown leech, with a whitish belly, that is made use of in medicine, and whose history best merits our curiosity.

The leech has the general figure of a worm, and is about as long as one's middle finger. Its skin is composed of rings, by means of which it is possessed of its agility, and swims in water. It contracts itself, when out of water, in such a manner, that when touched, it is not above an inch long. It has a small head, and a black skin, edged with a yellow line on each side, with some yellowish spots on the back. The belly also, which

is of a reddish colour, is marked with whitish yellow spots. But the most remarkable part of this animal is the mouth, which is composed of two lips, that take whatever form the insect finds convenient. When at rest, the opening is usually triangular; and within it are placed three very sharp teeth, capable of piercing not only the human skin, but also that of a horse or an ox. Still deeper in the head, is discovered the tongue, which is composed of a strong fleshy substance, and which serves to assist the animal in sucking, when it has inflicted its triple wound; for no sooner is this voracious creature applied to the skin, than it buries its teeth therein, then closes its lips round the wounds which it has made; and thus, in the manner of a cupping-glass, extracts the blood as it flows to the different orifices.

In examining this animal's form farther towards the tail, it is seen to have a gullet and an intestinal canal, into which the blood flows in great abundance. On each side of this are seen running along several little bladders, which, when the animal is empty, seem to be filled with nothing but water; but when it is gorging blood, they seem to communicate with the intestines, and receive a large portion of the blood which flows into the body. If these bladders should be considered as so many stomachs, then every leech will be found to have twenty-four. But what is most extraordinary of all in this animal's formation is, that though it takes so large a quantity of food, it has no anus or passage to eject it from the body when it has been digested. On the contrary, the blood which the leech has thus sucked, remains for several months clotted within its body, blackened a little by the change, but no way putrified, and very little altered in its texture or consistence. In what manner it passes through the animal's body, or how it contributes to its nourishment, is not easily accounted for. The water in which they are kept is very little discoloured by their continuance; they cannot be supposed to return the blood by the same passage through which it was taken in; it only remains, therefore, that it goes off through the pores of the

body, and that these are sufficiently large to permit its exclusion.

But it is not in this instance alone that the leech differs from all other insects. It was remarked, in a former chapter, that the whole insect tribe had the opening into their lungs placed in their sides, and that they breathed through those apertures as other animals through the mouth. A drop of oil poured on the sides of a wasp, a bee, or a worm, would quickly suffocate them, by stopping up the passages through which they breathe; but it is otherwise with the leech, for this animal may be immersed in oil without injury; nay, it will live therein; and the only damage it will sustain is, that when taken out, it will be seen to cast a fine pelucid skin exactly of the shape of the animal, after which it is as alert and vigorous as before. It appears from hence that the leech breathes through the mouth; and, in fact, it has a motion that seems to resemble the act of respiration in more perfect animals: but concerning all this, we are very much in the dark.

This animal seems to differ from all others in several respects; the rest of the reptile tribe are brought forth from eggs; the leech is viviparous, and produces its young, one after the other, to the number of forty or fifty at a birth. It is probable, that, like the snail, each insect contains the two sexes, and that it impregnates and is impregnated in the same manner. The young ones are chiefly found in the month of July, in shallow running waters, and particularly where they are tepified by the rays of the sun. The large ones are chiefly sought after; and being put into a glass vessel filled with water, they remain for months, nay for years, without taking any other subsistence. But they never breed in this confinement; and, consequently, what regards that part of their history, still remains obscure.

In this part of the world they seldom grow to above four inches; but in America and the east they are found from six to seven. Their pools there abound with them in such numbers, that it would be dangerous bathing there, if for no other

consideration. Our sailors and soldiers, who the last war were obliged to walk in those countries through marshy grounds, talk with terror of the number of leeches that infested them on their march. Even in some parts of Europe they increase so as to become formidable. Sedelius, a German physician, relates, that a girl of nine years old, who was keeping sheep near the city of Bomst in Poland, perceiving a soldier making up to her, went to hide herself in a neighbouring marsh among some bushes; but the number of leeches was so great in that place, and they stuck to her so close, that the poor creature expired from the quantity of blood which she lost by their united efforts. Nor is this much to be wondered at, since one of those insects that when empty generally weighs but a scruple, will, when gorged, weigh more than two drachms.

When leeches are to be applied, the best way is to take them from the water, in which they are contained, about an hour before, for they thus become more voracious and fasten more readily. When saturated with blood, they generally fall off of themselves; but if it be thought necessary to take them from the wound, care should be used to pull them very gently, or even to sprinkle them with salt if they continue to adhere; for if they be plucked rudely away, it most frequently happens that they leave their teeth in the wound, which makes a very troublesome inflammation, and is often attended with danger. If they be slow in fixing to the part, they are often enticed by rubbing it with milk or blood, or water mixed with sugar. As salt is a poison to most insects, many people throw it upon the leech when it has dropped from the wound, by which means it disgorges the blood it has swallowed, and it is then kept for repeated application. They seldom, however, stick after this operation; and as the price is but small, fresh leeches should always be applied whenever such an application is thought necessary.

P A R T. II.

C H A P. I.

Of the second Order of Insects.

IN the former part we gave a concise history of the most considerable insects, that, without wings, were produced in a perfect state; either from the body of the parent alive, like quadrupeds, or from the egg, in the manner of birds. We come now to a second order of insects, that are produced from the egg, like the former, but not in a perfect state; for, when first excluded, they are without wings. This, however, does not hinder the exercise of their animal functions; the insect, although not yet come to perfection, walks, leaps, and eats; nor is it ever deprived of motion, only that it rests a little when it is about to cast that part of its skin previous to its state of perfection. It is then seen to assume two wings, which, like a budding flower, burst through the case that contained them, and the animal becomes a winged insect in its state of highest perfection. To this order we may refer the libella, or dragon-fly; the formica leo, or lion-ant; the grasshopper, the locust; the cricket; the wood-cricket; the mole-cricket; the flea-locust; the flying-bug; the tipula; the water-scorpion; the notonecta, or water-fly, and many others.

C H A P. II.

Of the Libella or Dragon-Fly.

OF all the flies which adorn or diversify the face of nature, these are the most various and the most beautiful; they are of all colours; green, blue, crimson, scarlet, white; some unite a variety of the most vivid tints, and exhibit in one animal more different shades than are to be found in the rain-

bow. They are called, in different parts of the kingdom, by different names; but none can be at a loss to know them, as they are distinguished from all other flies by the length of their bodies, by the largeness of their eyes, and the beautiful transparency of their wings, which are four in number. They are seen in summer flying with great rapidity near every hedge, and by every running brook; they sometimes settle on the leaves of plants, and sometimes keep for hours together on the wing.

Dragon-flies, though there are three or four different kinds, yet agree in the most striking parts of their history, and one account may serve for all. The largest sort are generally found from two to three inches long; their tail is forked; their body divided into eleven rings; their eyes are large, horny, and transparent, divided by a number of intersections; and their wings, that always lie flat when they are at rest, are of a beautiful glossy transparency; sometimes shining like silver, and sometimes glistening like gold. Within the mouth are to be seen two teeth covered with a beautiful lip: with these the creatures bite fiercely when they are taken; but their bite is perfectly harmless, as I have experienced more than once.

These insects, beautiful as they are, are produced from eggs, which are deposited in the water, where they remain for some time without seeming life or motion. They are ejected by the female into the water in clusters, like a bunch of grapes, where they sink to the bottom by their natural weight, and continue in that state, till the young ones find strength enough to break the shell, and to separate from each other. The form in which they first show life, is that of a worm with six legs, bearing a strong resemblance to the dragon-fly in its winged state, except that the wings are yet concealed within a sheath peculiar to this animal. The rudiments of these appear in bunches on the back, within which the wings are folded up into each other, while all the colours and varieties of painting appear transparent through the skin. These animals, upon quitting the egg, still continue in the water, where they creep and

swim, but do not move swiftly. They have likewise a sharp sight, and immediately sink to the bottom, if any one comes to the places wherein they live, or whenever they perceive the least uncommon object. Their food at that time is soft mud and the glutinous earthy substances that are found at the bottom.

When these animals prepare to change from their reptile to their flying state, they then move out of the water to a dry place ; as into grass ; to pieces of wood, stone, or any thing else they meet with. They there firmly fix their acute claws ; and, for a short time, continue quite immoveable, as if meditating on the change they are to undergo. It is then observed, that the skin first opens on the head and back ; and out of this opening they exhibit their real head and eyes, and at length their six legs ; whilst, in the mean time, the hollow and empty skin, or slough of their legs, remains firmly fixed in its place. After this, the enclosed creature creeps forward by degrees ; and, by this means, draws first its wings and then its body out of the skin ; and proceeding a little farther, sits at rest for some time, as if immoveable. During this time, the wings, which were moist and folded, begin by degrees to expand themselves, and to make smooth and even all those plaits which were laid against each other, like a closed fan. The body is likewise insensibly extended, until all the limbs have obtained their proper size and dimensions. All these surprizing and difficult operations are accomplished by the force of the blood and the circulating humours. The creature cannot at first make use of its new wings, and, therefore, is forced to stay in the same place, until all its limbs are dried by the circumambient air. It soon, however, begins to enter upon a more noble life than it had hitherto led in the bottom of the brook ; and from creeping slowly and living accidentally, it now wings the air, and makes choice from amidst the variety of its provisions.

Indeed, no animal is more amply fitted for motion, subsistence and enjoyment. As it haunts and seeks after its food flying in the air, nature has provided it with two large eyes, which make almost the whole head, and which resemble glittering

mother-of pearl. It has also four expansive silver-coloured wings, with which, as with oars, it can turn itself with prodigious velocity ; and to assist these, it is furnished with a very long body, which, like a rudder, directs its motions. As the wings are long and the legs short, they seldom walk, but are ever seen either resting or flying. For this reason, they always choose dry branches of trees or shrubs to remain on; and when they have refreshed themselves a little, they renew their flight. Thus they are seen adorning the summer with a profusion of beauty, lightly traversing the air in a thousand directions, and expanding the most beautiful colours to the sun. The garden, the forest, the hedges, and the rivulets, are animated by their sports; and there are few who have been brought up in the country, who have not employed a part of their childhood in the pursuit.

But while these beautiful flies appear to us so idly and innocently employed, they are in fact the greatest tyrants of the insect tribe; and, like the hawk among birds, are only hovering up and down to seize their prey. They are the strongest and the most courageous of all winged insects; nor is there one, how large soever, that they will not attack and devour. The blue fly, the bee, the wasp, and the hornet, make their constant prey; and even the butterfly, that spreads so large a wing, is often caught and treated without mercy. Their appetite seems to know no bounds: they spend the whole day in the pursuit, and have been seen to devour three times their own size in the capture of a single hour. They seize their prey flying with their six claws, and tear it easily to pieces with their teeth, which are capable of inflicting troublesome wounds.

But the males are upon the wing for another purpose beside that of food, as they are very salacious, and seek the females with great ardour. The sun no sooner begins to warm the fields, than the males are found assiduously employed each in seeking its mate; and no sooner does a female appear, but two or three males are seen pursuing and endeavouring to seize her with all their arts and agility. The instrument of generation

in the male is placed very different from that of any other insect, being not at the end of the tail as in others, but immediately under the breast, and consequently, at first view, incapable of being united to the sexual part of the female: which, as in other insects, lies in the tail. To perform this junction, nature has provided the male with a very peculiar manner of proceeding. As soon as he perceives the female, and finds himself sufficiently near, he seizes upon the back of her head by surprise, and fastening his claws upon her, turns round his forky tail, which he fastens round her neck, and, in this manner, fixes himself so closely and firmly, that no efforts can remove him. It is in vain that she flies from one branch to another, and settles upon them; he still keeps fixed, and often continues in this situation for three or four hours successively. When he flies, she is obliged to fly with him; but he still directs the way: and though she moves her wings, she seems entirely guided by his motions. As yet, however, the business of impregnation is not performed: for to this the female must contribute, and she at last seems, by the continuance of her constraint, to comply: for turning up the end of her tail to that part of the breast of the male in which lies the part proper for generation, both instruments meet, and the eggs of the female receive the necessary fecundation. An hour or two after this, she flies to some neighbouring pool, where she deposits her eggs, as was already mentioned. There they continue in a reptile state for a year, and then are changed into a beautiful fly, resembling the parent.

C H A P. III.

Of the Formica Leo, or Lion-Ant.

ALTHOUGH this animal properly belongs to no order of insects, yet, as it is changed into a fly, very much resembling that described in the preceding chapter, it may not

be improper to give its history here. If we consider the life of this animal in its different stages of existence, we shall find it equally wonderful in all, but as it changes to a dragon-fly, what we have said of that animal above need not be repeated here. The lion-ant, when it becomes an inhabitant of air, in every respect resembles that which has been already described; its glossy wings, its voracious appetites, its peculiar manner of generation, are entirely the same. It is in its reptile state that it differs from all other insects, and, in that state, it will be amusing to pursue its history.

The lion-ant, in its reptile state, is of the size of a common wood-louse, but somewhat broader. It has a pretty long head and a roundish body, which becomes a little narrower towards the tail. The colour is a dirty grey, speckled with black, and the body is composed of several flat rings, which slip one upon another. It has six feet, four of which are fixed to the breast, and two to the neck. The head is small and flat, and before, there are two little smooth horns or feelers, which are hard, about a quarter of an inch long, and crooked at the ends. At the basis of the feelers there are two small black lively eyes, by which it can see the smallest object, as is easily discovered by its starting from every thing that approaches.

To a form so unpromising, and so ill provided for the purposes of rapacity, this animal unites the most ravenous appetites in nature; but to mark its imbecility still stronger, as other animals have wings or feet to enable them to advance towards their prey, the lion-ant is unprovided with such assistance from either. It has legs indeed; but these only enable it to run backward, so that it could as soon die as make the smallest progressive motion. Thus, famished and rapacious as it ever seems, its prey must come to it, or rather into the snare provided for it, or the insidious assassin must starve.

But nature, that has denied it strength or swiftness, has given it an equivalent in cunning, so that no animal fares more sumptuously, without ever stirring from its retreat. For this purpose, it chooses a dry sandy place, at the foot of a wall, or un-

der some shelter, in order to preserve its machinations from the rain. The driest and most sandy spot is the most proper for it ; because a heavy clogged earth would defeat its labour. When it goes about to dig the hole where it takes its prey, it begins to bend the hinder part of its body, which is pointed, and thus works backward, making, after several attempts, a circular furrow, which serves to mark out the size of the hole it intends making, as the ancients marked out the limits of a city with the plough. Within this first furrow it digs a second, then a third, and afterwards others, which are always less than the preceding. Then it begins to deepen its hole, sinking lower and lower into the sand, which it throws with its horns, or feelers, towards the edges, as we see men throw up sand in a gravel-pit. Thus, by repeating its labours all round, the sand is thrown up in a circle about the edge of the pit, until the whole is quite completed. This hole is always formed in a perfect circle, and the pit itself resembles the inside of an inverted funnel. When this insect first leaves the egg, and is newly hatched, the first pit it makes is very small ; but as it grows bigger, it makes a larger hole ; which is destined, like a pit-fall, to entrap its prey. It is generally about two inches deep, and as much in diameter.

The work being thus with great labour finished, the insidious insect places itself in ambush, hiding itself at the bottom under the sand in such a manner, that its two horns encircle the bottom of the pit. All the sides of this pit-fall are made of the most loose and crumbling materials ; so that scarce any insect can climb up that has once got down to the bottom. Conscious of this, the lion-ant remains in patient expectation, ready to profit by that accident which throws some heedless little animal into its den. If then, by misfortune, an ant, a wood-louse, or a small caterpillar walks too near the edge of the precipice, the sand gives way beneath them, and they fall to the bottom of the pit, where they meet inevitable destruction. The fall of a single grain of sand gives the murderer notice at the bottom of its cave ; and it never fails to sally forth to seize upon its prey. It happens sometimes, however, that the ant or the wood-

louse is too nimble, and runs up the sides of the pit-fall before the other can make ready to seize it. The lion-ant has then another contrivance, still more wonderful than the former; for, by means of its broad head and feelers, it has a method of throwing up a shower of sand, which falls upon the struggling captive with tremendous weight, and once more crushes it down to the bottom. When the insect is once fallen thus low, no efforts can retrieve or release it: the lion-ant seizes it with its feelers, which are hollow, and darting them both into its body, sucks out all the little animal's juices with the utmost rapacity.

When the prey is thus reduced to a husk, and nothing but the external form remains, the next care of the murderer is to remove the body from its cell; since the appearance of dead carcases might forewarn other insects of the danger of the place. The insect, therefore, takes up the wasted trunk with its feelers, and throws it, with wonderful strength, at least six inches from the edge of its hole; and then patiently sets about mending the breaches which its fortifications had received in the last engagement. Nothing can abate its industry, its vigilance, its patience or its rapacity. It will work for a week together to make its pit-fall; it will continue upon the watch for more than a month, patiently expecting the approach of its prey; and if it comes in greater quantities than is needful, yet still the little voracious creature will quit the insect it has newly killed, and leave it half eaten, to kill and attack any other that happens to fall within the sphere of its malignity: though so voracious, it is surprizingly patient of hunger; some of them having been kept in a box with sand for six months and upwards, without feeding at all.

When the lion-ant attains a certain age, in which it is to change into another form, it then leaves off its usual rapacious habits, but keeps on its industry. It no longer continues to make pits, but furrows up the sand all round in an irregular manner; testifying those workings and violent agitations which most insects exhibit previous to their transformation.

These animals are produced in autumn, and generally live a year, and perhaps two, before they assume a winged form. Certain it is, that they are found at the end of winter of all sizes ; and it would seem that many of the smaller kinds had not yet attained sufficient maturity for transformation. Be this as it may, when the time of change approaches, if the insect finds its little cell convenient, it seeks no other : if it is obliged to remove, after furrowing up the sand, it hides itself under it, horns and all. It there spins a thread, in the manner of the spider ; which being made of a glutinous substance, and being humid from the moisture of its body, sticks to the little particles of sand among which it is spun ; and in proportion as it is thus excluded, the insect rolls up its web, sand and all, into a ball, of which itself is the centre. This ball is about half an inch in diameter ; and within it the insect resides, in an apartment sufficiently spacious for all its motions. The outside is composed of sand and silk ; the inside is lined with silk only, of a fine pearl colour, extremely delicate ; and perfectly beautiful. But though the work is so curious within, it exhibits nothing to external appearance, but a lump of sand ; and thus escapes the search of birds, that might otherwise disturb the inhabitant within.

The insect continues thus shut up for six weeks or two months ; and gradually parts with its eyes, its feelers, its feet, and its skin ; all which are thrust into a corner of the inner apartment, like a rag. The insect then appears almost in its winged state, except that there is a thin skin which wraps up the wings, and that appears to be nothing else but a liquor dried on their outside. Still, however, the little animal is too delicate and tender to venture from its retreat ; but continues enclosed for some time longer : at length, when the members of this new insect have acquired the necessary consistence and vigour, it tears open its lodging, and breaks through its wall. For this purpose it has two teeth, like those of grasshoppers, with which it eats through, and enlarges the opening, till it gets out. Its body, which is turned like a screw, takes up no more than the space of a quarter of an inch ; but when

it is unfolded, it becomes half an inch in length ; while its wings, that seemed to occupy the smallest space, in two minutes time unfold, and become longer than the body. In short, it becomes a large and beautiful fly of the libellula kind, with a long slender body, of a brown colour ; a small head, with large bright eyes, long slender legs, and four large transparent reticulated wings. The rest of its habits resemble that insect whose form it bears ; except, that instead of dropping its eggs in the water, it deposits them in sand, where they are soon hatched into that rapacious insect so justly admired for its method of catching its prey.

C H A P. IV.

Of the Grasshopper, the Locust, the Cicada, the Cricket and the Mole-Cricket.

BELONGING to the second order of insects, we find a tribe of little animals, which, though differing in size and colour, strongly resemble each other in figure, appetites, nature, and transformation. But though they all appear of one family, yet man has been taught to hold them in different estimation ; for while some of this tribe amuse him with their chirpings, and banish solitude from the fields, others come in swarms, eat up every thing that is green, and, in a single night, convert the most delightful landscape into a dreary waste. However, if these animals be separately considered, the devouring locust is not in the least more mischievous than the musical grasshopper ; the only difference is, that one species come for food in a swarm, the other feeds singly.

That animal which is called the grasshopper with us, differs greatly from the cicada of antiquity ; for, as our insect is active enough in hopping through the long grass, from whence it has taken its name, the cicada had not this power, but ci-

ther walked or flew. The little hissing note also of our grasshopper is very different from the song of the cicada, which was louder and far more musical. The manner in which this note is produced by the two animals is very different; for the cicada makes it by a kind of buckler, which the male has beneath its belly; the grasshopper, by a transparent membrane, that covers a hole at the base of its wings. There is still a greater variety in all these with regard to shape and colour. Some are green, some black, some livid, and some variegated; but many of them do not show all their colours till they fly. Some have long legs, some short; some with more joints, others with fewer. Some sing, others are mute; some are innocent, doing no damage to the husbandman; while others do such prodigious mischief, that they are looked upon in some countries as one of the terrible scourges of the incensed Divinity.

Of this variegated tribe, the little grasshopper that breeds in such plenty in every meadow, and that continues its chirping through the summer, is best known to us; and, by having its history, we shall be possessed of that of all the rest. This animal is of the colour of green leaves, except a line of brown which streaks the back, and two pale lines under the belly and behind the legs. It may be divided into the head, the corslet and the belly. The head is oblong, regarding the earth, and bearing some resemblance to that of a horse. Its mouth is covered by a kind of round buckler jutting over it, and armed with teeth of a brown colour, hooked at the points. Within the mouth is perceivable a large reddish tongue, and fixed to the lower jaw. The feelers or horns are very long, tapering off to a point; and the eyes are like two black specks a little prominent. The corslet is elevated, narrow, armed above and below, by two serrated spines. The back is armed with a strong buckler, to which the muscles of the legs are firmly bound, and round these muscles are seen the vessels by which the animal breathes, as white as snow. The last pair of legs are much longer and stronger than the first two pair, fortified by thick muscles, and very well formed for leaping. It

has four wings ; the anterior ones springing from the second pair of legs, the posterior from the third pair. The hinder wings are much finer and more expansive than the foremost, and are the principal instruments of its flight. The belly is considerably large, composed of eight rings, and terminated by a forky tail, covered with down, like the tail of a rat. When examined internally, besides the gullet, we discover a small stomach ; and behind that, a very large one, wrinkled and furrowed within : lower down there is still a third ; so that it is not without reason that all the animals of this order are said to chew the cud, as they so much resemble ruminant animals in their internal conformation.

A short time after the grasshopper assumes its wings, it fills the meadow with its note ; which, like that among birds, is a call to courtship. The male only of this tribe is vocal ; and, upon examining at the base of the wings, there will be found a little hole in its body, covered with a fine transparent membrane. This is thought, by Linnæus, to be the instrument it employs in singing ; but others are of opinion the sound is produced by rubbing its hinder legs against each other : however this be, the note of one male is seldom heard, but it is returned by another ; and the two little animals, after many mutual insults of this kind, are seen to meet and fight desperately. The female is generally the reward of victory ; for, after the combat, the male seizes her with his teeth behind the neck, and thus keeps her for several hours, till the business of fecundation is performed. They are at that time so strongly united, that they can scarcely be separated without tearing asunder. Towards the latter end of autumn the female prepares to deposit her burthen ; and her body is then seen greatly distended with her eggs, which she carries to the number of one hundred and fifty. In order to make a proper lodgment in the earth for them, nature has furnished her with an instrument at her tail, somewhat resembling a two-edged sword, which she can sheathe and unsheathe at pleasure : with this she pierces the earth as deep as she is able ; and into the hole

which her instrument has made, she deposits her eggs one after the other.

Having thus provided for the continuation of her posterity, the animal herself does not long survive; but, as the winter approaches, she dries up, seems to feel the effects of age, and dies from a total decay. Some, however, assert, that she is killed by the cold; and others, that she is eaten by worms: but certain it is, that neither the male nor female are ever seen to survive the winter. In the mean time the eggs which have been deposited, continue unaltered, either by the severity of the season, or the retardation of the spring. They are of an oval figure, white, and of the consistence of horn: their size nearly equals that of a grain of anise: they are enveloped in the body within a covering, branched all over with veins and arteries; and when excluded, they crack, on being pressed between the fingers: their substance within, is a whitish, viscous and transparent fluid. In this manner they remain deposited beneath the surface of the earth, during the whole winter; till the genial return of spring begins to vivify and hatch them. The sun with its warmth, beginning to animate all nature, the insect eggs feel its benign influence; and generally about the beginning of May, every egg produces an insect, about the size of a flea. These at first are of a whitish colour; at the end of two or three days they turn black; and soon after they become of a reddish brown. They appear, from the beginning, like grasshoppers wanting wings; and hop among the grass, as soon as excluded, with great agility.

Yet still they are by no means arrived at their state of full perfection; although they bear a strong resemblance to the animal in its perfect form. They want, or seem to want the wings, which they are at last seen to assume; and can only hop among the grass, without being able to fly. The wings, however, are not wanting, but are concealed within four little bunches, that seem to deform the sides of the animal: there they lie rolled up in a most curious manner; and occupying a smaller space than one would conceive who saw them ex-

tended. Indeed, all insects, whatever transmutations they seem to undergo, are yet brought forth with those very limbs, parts and wings, which they afterwards seem to acquire. In the most helpless caterpillar, there are still to be seen the rudiments of that beautiful plumage which it afterwards expands when a butterfly ; and though many new parts seem unfolded to the view, the animal acquires none but such as it was from the beginning possessed of. The grasshopper, therefore, though seemingly without wings, is in reality, from the first, possessed of those instruments, and only waits for sufficient force to break the bonds that hold them folded up, and to give them their full expansion.

The grasshopper, that for above twenty days from its exclusion has continued without the use of its wings, which were folded up to its body, at length prepares for its emancipation, and for a life of greater liberty and pleasure. To make the proper dispositions for the approaching change, it ceases from its grassy food, and seeks about for a convenient place, beneath some thorn or thistle, that may protect it from an accidental shower. The same laborious writhings and workings, heavings and palpitations, which we have remarked in every other insect upon an approaching change, are exhibited in this. It swells up its head and neck ; it then seems to draw them in again ; and thus alternately, for some time, it exerts its powers to get free. At length, the skin covering the head and breast, is seen dividing above the neck ; the head is seen issuing out first from the bursting skin ; the efforts still continuing, the other parts follow successively ; so that the little animal, with its long feelers, legs and all, works its way from the old skin, that remains fixed to the thistle or the thorn. It is, indeed, inconceivable how the insect can thus extricate itself from so exact a sheath as that which covered every part of its body.

The grasshopper, thus disengaged from its outer skin, appears in its perfect form ; but then so feeble, and its body so soft and tender, that it may be molded like wax. It is no

longer of that obscure colour which it exhibited before, but a greenish white, which becomes more vivid as the moisture on the surface is dried away. Still, however, the animal continues to show no signs of life, but appears quite spent and fatigued with its labour for more than an hour together. During this time, the body is drying, and the wings unfolding to their greatest expansion, and the curious observer will perceive them, fold after fold, opening to the sun, till at last they become longer than the two hinder legs. The insect's body also is lengthened during this operation, and it becomes much more beautiful than before.

These insects are generally vocal in the midst of summer; and they are heard at sun-setting much louder than during the heats of the day. They are fed upon grass; and, if their belly be pressed, they will be seen to return the juices of the plants they have last fed upon. Though unwilling to fly, and slow in flight, particularly when the weather is moist or cool, they are sometimes seen to fly to considerable distances. If they are caught by one of the hinder legs, they quickly disengage themselves from it, and leave the leg behind them. This, however, does not grow again, as with crabs or spiders; for as they are animals but of a single year's continuance, they have not sufficient time for repairing those accidental misfortunes. The loss of their leg also prevents them from flying; for, being unable to lift themselves in the air, they have not room upon the ground for the proper expansion of their wings. If they be handled roughly, they will bite very fiercely; and when they fly, they make a noise with their wings. They generally keep in the plain, where the grass is luxuriant, and the ground rich and fertile: there they deposit their eggs, particularly in those cracks which are formed by the heat of the sun.

Such are the habits and nature of those little vocal insects, that swarm in our meadows, and enliven the landscape. The larger kinds only differ from them in size, in rapidity of flight, and the powers of injuring mankind, by swarming upon the

productions of the earth. The quantity of grass, which a few grasshoppers that sport in the fields can destroy is trifling; but when a swarm of locusts, two or three miles long, and several yards deep, settle upon a field, the consequences are frightful. The annals of every country are marked with the devastation which such a multitude of insects produces; and though they seldom visit Europe in such dangerous swarms as formerly, yet, in some of the southern kingdoms, they are still formidable. Those which have at uncertain intervals visited Europe in our memory, are supposed to have come from Africa, and the animal is called the great brown locust. It was seen in several parts of England in the year 1748, and many dreadful consequences were apprehended from its appearance. This insect is about three inches long; and has two horns or feelers, an inch in length. The head and horns are of brownish colour; it is blue about the mouth, as also on the inside of the larger legs. The shield that covers the back is greenish; and the upper side of the body brown, spotted with black, and the under side purple. The upper wings are brown, with small dusky spots, with one larger at the tips; the under wings are more transparent, and of a light brown, tinged with green, but there is a dark cloud of spots near the tips. This is that insect that has threatened us so often with its visitations; and that is so truly terrible in the countries where it is bred. There is no animal in the creation that multiplies so fast as these, if the sun be warm, and the soil in which their eggs are deposited be dry. Happily for us, the coldness of our climate, and the humidity of our soil, are no way favourable to their production; and as they are but the animals of a year, they visit us and perish.

The scripture, which was written in a country where the locust made a distinguished feature in the picture of nature, has given us several very striking images of this animal's numbers and rapacity. It compares an army, where the numbers are almost infinite, to a swarm of locusts: it describes them as rising out of the earth, where they are produced; as pur-

ſuing a ſettled march to deſtroy the fruits of the earth, and co-operate with Divine Indignation.

When the locuſts take the field, as we are aſſured, they have a leader at their head, whoſe flight they obſerve, and pay a ſtrict attention to all his motions. They appear, at a diſtance, like a black cloud, which, as it approaches, gathers upon the horizon, and almoſt hides the light of the day. It often happens that the huſbandman ſees this imminent calamity paſs away without doing any miſchief; and the whole ſwarm proceed onward, to ſettle upon the labours of ſome leſs fortunate country. But wretched is the diſtrict upon which they ſettle: they ravage the meadow and the paſture ground; ſtrip the trees of their leaves, and the garden of its beauty: the viſitation of a few minutes deſtroys the expectation of a year; and a famine but too frequently enſues. In their native tropical climates they are not ſo dreadful as in the more ſouthern parts of Europe. There, though the plain and the foreſt be ſtripped of their verdure, the power of vegetation is ſo great, that an interval of three or four days repairs the calamity: but our verdure is the livery of a ſeaſon; and we muſt wait till the enſuing ſpring repairs the damage. Beſides, in their long flights to this part of the world, they are ſatiſhed by the tediousneſs of their journey, and are therefore more voracious wherever they happen to ſettle. But it is not by what they devour that they do ſo much damage as by what they deſtroy. Their very bite is thought to contaminate the plant, and to prevent its vegetation. To uſe the expreſſion of the huſbandman, they burn whatever they touch; and leave the marks of their deſtroy for two or three years enſuing. But if they be noxious while living, they are ſtill more ſo when dead; for wherever they fall, they infect the air in ſuch a manner that the ſmell is inſupportable. Oroſius tells us, that in the year of the world 3800, there was an incredible number of locuſts which infected Africa; and, after having eaten up every thing that was green, they flew off, and were drowned in the African ſea; where they cauſed ſuch a ſtench, that

the putrifying bodies of hundreds of thousands of men could not equal it.

In the year 1690, a cloud of locusts was seen to enter Russia in three different places ; and from thence to spread themselves over Poland and Lithuania, in such astonishing multitudes, that the air was darkened, and the earth covered with their numbers. In some places they were seen lying dead, heaped upon each other four feet deep ; in others, they covered the surface like a black cloth ; the trees bent beneath their weight ; and the damage which the country sustained exceeded computation. In Barbary their numbers are formidable, and their visits are frequent. In the year 1724, doctor Shaw was a witness in that country of their devastations. Their first appearance was about the latter end of March, when the wind had been southerly for some time. In the beginning of April, their numbers were so vastly increased, that in the heat of the day they formed themselves into large swarms, which appeared like clouds, and darkened the sun. In the middle of May they began to disappear, retiring into the plains to deposit their eggs. In the next month, being June, the young brood began to make their appearance, forming many compact bodies of several hundred yards square ; and afterwards marching forward, climbed the trees, walls, and houses, eating every thing that was green in their way. The inhabitants, to stop their progress, laid trenches all over their fields and gardens, filling them with water. Some placed large quantities of heath, stubble, and such like combustible matter, in rows, and set them on fire on the approach of the locusts. But all this was to no purpose ; for the trenches were quickly filled up, and the fires put out by the vast number of swarms that succeeded each other. A day or two after one of these was in motion, others, that were just hatched, came to glean after them, gnawing off the young branches and the very bark of the trees. Having lived near a month in this manner, they arrived at their full growth, and threw off their worm-like state, by casting their skins. To prepare themselves for this change, they fix their hinder feet to some bush or twig,

or corner of a stone, when, immediately, by an undulating motion, used on this occasion, their heads would first appear, and soon after the rest of their bodies. The whole transformation was performed in seven or eight minutes time; after which they were a little while in a languishing condition; but as soon as the sun and air had hardened their wings, and dried up the moisture that remained after casting off their sloughs, they returned again to their former greediness, with an addition both of strength and agility. But they did not continue long in this state before they were entirely dispersed; after laying their eggs, directing their course northward, and probably perished in the sea. It is said that the holes these animals make, to deposit their eggs, are four feet deep in the ground; the eggs are about fourscore in number, of the size of caraway comfits, and bundled up together in clusters.

It would be endless to recount all the mischiefs which these famished insects have at different times occasioned; but what can have induced them to take such distant flights when they come into Europe, is not so easy to be accounted for. It seems most probable, that by means of a very dry season in the heart of Africa, they are propagated in such numbers, that the vegetables of the spot where they are produced are not sufficient to sustain them. Thus being obliged to find out other countries, they traverse the sandy deserts, where they can find no sustenance; still meeting with nothing to allure them from their height, they proceed forward across the sea, and thus come into Europe, where they alight upon the first green pastures that occur.

In some parts of the world, the inhabitants turn what seems a plague to their own advantage. Locusts are eaten by the natives in many kingdoms of the east; and are caught in small nets provided for that purpose. They parch them over the fire in an earthen pan; and when their wings and legs are fallen off, they turn reddish, of the colour of boiled shrimps. Dampier has ate them thus prepared, and thinks them a tolerable dish. The natives of Barbary also eat them fried with salt; and they are said to taste like cray-fish.

There is a locust in Tonquin, about the bigness of the top of a man's finger, and as long as the first joint. It breeds in the earth, in low grounds ; and in the months of January and February, which is the season for taking them, they issue from the earth in vast swarms. At first they can hardly fly, so that they often fall into the rivers in great numbers : however, the natives in these months watch the rivers, and take them up in multitudes in small nets. They either eat them fresh, broiled on the coals, or pickle them for keeping. They are considered as a great delicacy in that part of the world, as well by the rich as the poor. In the countries where they are eaten, they are regularly brought to market, and sold as larks or quails in Europe. They must have been a common food with the Jews ; as Moses, in the book of Leviticus, permits them to eat four different kinds of this animal, which he takes care to specify. This dish, however, has not yet made its way into the kitchens of the luxurious in Europe ; and though we may admire the delicacies of the east, we are as yet happily deprived of the powers of imitation.

Of all animals, however, of this noxious tribe, the great West-India locust, individually considered, is the most formidable. It is about the thickness of the barrel of a goose-quill, and the body is divided into nine or ten joints, in the whole about six or seven inches long. It has two small eyes, standing out of the head like those of crabs, and two feelers like long hair. The whole body is studded with small excrescences, which are not much bigger than the points of pins. The shape is roundish, and the body diminishes in circumference to the tail, which is forked into two horns. Between these, there is a sort of a sheath containing a small dangerous sting. If any person happens to touch this insect he is sure to be stung ; and is immediately taken with a shivering and trembling all over the body ; which, however, may soon be put a stop to, by rubbing the place that was affected with a little palm oil.

From the locust we descend to the cricket, which is a very inoffensive and pretty animal. Though there be a species of

this insect that lives entirely in the woods and fields, yet that with which we are best acquainted, is the house cricket, whose voice is so well known behind a country fire in a winter's evening. There is something so unusual in hearing a sound while we do not see the animal producing it, nor discover the place from whence it comes, that among the country people the chirping of the cricket is always held ominous; and whether it deserts the fire-side, or pays an unexpected visit, the credulous peasantry always find something to be afraid of. In general, however, the killing of a cricket is considered as an unlucky omen; and though their company is not much desired, yet no methods must be taken to remove them.

The cricket very much resembles the grasshopper in its shape, its manner of ruminating, its voice, its leaping, and methods of propagation. It differs in its colour, which is uniformly of a rusty brown; in its food, which is more various; and in its place of residence, which is most usually in the warmest chinks behind a country hearth. They are, in some measure, obliged to the bad masonry employed in making peasants' houses for their retreats. The smallest chink serves to give them shelter; and where they once make their abode, they are sure to propagate. They are of a most chilly nature, seldom leaving the fire-side; and if undisturbed, are seen to hop from their retreats to chirrup at the blaze in the chimney. The wood-cricket is the most timorous animal in nature; but the chimney cricket, being used to noises, disregards not only those, but the appearance of people near it. Whether the voice of this animal is formed in the same manner with that of the grasshopper, by a fine membrane at the base of the wings, which is moved by a muscle, and which being coiled up, gives a sound like a quail-pipe, is not yet ascertained; nor do we well know the use of this voice, since anatomical inspection has not yet been able to discover the smallest organs of hearing. Still, however, we can make no doubt of their power of distinguishing sounds, though probably not in the same manner with the more perfect ranks of nature. Certain

it is, that I have often heard them call, and this call was as regularly answered by another, although none but the males are vocal.

As the cricket lives chiefly in the dark, so its eyes seem formed for the gloominess of its abode; and those who would surprise it, have only to light a candle unexpectedly; by which it is dazzled, and cannot find the way back to its retreat. It is a very voracious little animal, and will eat bread, flour and meat; but it is particularly fond of sugar. They never drink, but keep for months together at the back of the chimney, where they could possibly have had no moisture. The warmth of their situation only serves to increase their mirth and loquacity. Except in the very coldest weather, they never cease their chirruping, but continue that little piercing note, which is as pleasing to some as it is disagreeable to others. The great Scaliger was particularly delighted with the chirruping of crickets, and kept several of them for his amusement, enclosed in a box, which he placed in a warm situation. Others, on the contrary, think there is something ominous and melancholy in the sound, and use every endeavour to banish this insect from their houses. Ledelius tells us of a woman who was very much incommoded by crickets, and tried, but in vain, every method of banishing them from her house. She at last accidentally succeeded; for having one day invited several guests to her house, where there was a wedding, in order to increase the festivity of the entertainment, she procured drums and trumpets to entertain them. The noise of these was so much greater than what the little animals were used to, that they instantly forsook their situation, and were never heard in that mansion more.

But, of all the cricket kind, that which is called the mole-cricket is the most extraordinary. This animal is the largest of all the insects with which we are acquainted in this country, being two inches and a half in length, and three quarters of an inch in breadth. The colour is of a dusky brown; and at the extremity of the tail, there are two hairy excrescences, resembling, in some sense, the tail of a mouse. The body con-

lifts of eight scaly joints or separate folds, is brown on the upper part, and more deeply tinged below. The wings are long, narrow, and terminate in a sharp point, each having a blackish line running down it : however, when they are extended, they appear to be much broader than could at first sight be supposed. The shield of the breast is of a firm texture, of a blackish colour, and hairy. The fore feet, which are this animal's principal instruments of burrowing into the earth, are strong, webbed and hairy ; it generally, however, runs backward ; but it is commonly under-ground, where it burrows even faster than a mole. It is thought also to be amphibious ; and capable of living under water, as well as under ground.

Of all insects, this is the most detested by gardeners, as it chiefly resides in that ground which lies light, and where it finds sufficient plenty under the surface. Thus, in a single night's time, it will run along a furrow which has been newly sown, and rob it of all its contents. Its legs are formed in such a manner, that it can penetrate the earth in every direction ; before, behind, and above it. At night it ventures from its under-ground habitation, and, like the cricket, has its chirping call. When the female is fecundated, she makes a cell of clammy earth, the inside of which is large enough to hold two hazel-nuts ; and in this she lays her eggs. The whole nest is about the size of a common hen's egg, close up on every side, and well defended from the smallest breath of air. The eggs generally amount to the number of a hundred and fifty, being white, and about the size of a carraway comfit. They are thus carefully covered as well to defend them from the injuries of the weather, as from the attacks of the black-beetle ; that being itself an under-ground inhabitant, would, but for this precaution, devour or destroy them. To prevent this, the female mole cricket is often posted as a centinel near the nest, and when the black invader plunges in to seize its prey, the guardian insect seizes him behind, and instantly bites him in two.

Nothing can exceed the care and assiduity which these ani-

mals exhibit in the preservation of their young. Wherever the nest is placed, there seems to be a fortification, avenues and entrenchments, drawn round it : there are numberless winding ways that lead to it, and a ditch drawn about it, which few of its insect enemies are able to pass. But their care is not confined to this only; for, at the approach of winter, they carry their nest entirely away, and sink it deeper in the ground, so that the frost can have no influence in retarding the young brood from coming to maturity. As the weather grows milder, they raise their magazine in proportion ; till, at last, they bring it as near the surface as they can, to receive the genial influence of the sun, without wholly exposing it to view : yet, should the frost unexpectedly return, they sink it again as before.

C H A P. V.

Of the Earwig, the Froth Insect, and others belonging to the second Order of Insects.

WE should still keep in memory that all insects of the second order, though not produced quite perfect from the egg, yet want very little of their perfection, and require but a very small change to arrive at that state which fits them for flight and generation. The natural functions in these are never suspended : from the instant they leave the egg, they continue to eat, to move, to leap, and pursue their prey : a flight change ensues ; a skin that enclosed a part of their body and limbs, bursts behind, like a woman's stays, and gives freedom to a set of wings with which the animal expatiates, and flies in pursuit of its mate.

Of all this class of insects, the earwig undergoes the smallest change. This animal is so common, that it scarce needs a description ; its swiftness in the reptile state is not less remark-

able than its indefatigable velocity when upon the wing. That it must be very prolific, appears from its numbers; and that it is very harmless, every one's experience can readily testify. It is provided with six feet, and two feelers: the tail is forked; and with this it often attempts to defend itself against every assailant. But its attempts are only the threats of impotence; they draw down the resentment of powerful animals, but no way serve to defend it. The deformity of its figure, and its slender make, have also subjected it to an imputation, which, though entirely founded in prejudice, has more than once procured its destruction. It is supposed, as the name imports, that it often enters into the ears of people sleeping; thus causing madness from the intolerable pain, and soon after death itself. Indeed, the French name, which signifies the ear-piercer, urges the calumny against this harmless insect, in very plain terms: yet nothing can be more unjust; the ear is already filled with a substance which prevents any insect from entering; and besides, it is well lined and defended with membranes, which would keep out any little animal, even though the ear-wax were away. These reproaches, therefore, are entirely groundless: but it were well if the accusations which gardeners bring against the ear-wig were as slightly founded. There is nothing more certain than that it lives among flowers, and destroys them. When fruit also has been wounded by flies, the earwig generally comes in for a second feast, and sucks those juices which they first began to broach. Still, however, this insect is not so noxious as it would seem; and seldom is found but where the mischief has been originally begun by others. Like all of this class, the earwig is hatched from an egg. As there are various kinds of this animal, so they choose different places to breed in: in general, however, they lay their eggs under the bark of plants, or in the clefts of trees, when beginning to decay. They proceed from the egg in that reptile state in which they are most commonly seen; and, as they grow larger, the wings, bound under the skin, begin to burgeon. It is amazing how very little room four large wings take up before they are protruded; for no person could ever conceive such an ex-

panfion of natural drapery could be rolled up in fo fmall a pacquet. The fheath in which they are enveloped, folds and covers them fo neatly, that the animal feems quite deftitute of wings* ; and even when they are burft from their confinement, the animal, by the power of the mufcles and joints which it has in the middle of its wings, can clofely fold them into a very narrow compafs. When the earwig has become a winged infect, it flies in purfuit of the female, ceafing to feed, and is wholly employed in the bufinefs of propagation. It lives, in its winged ftate, but a few days ; and having taken care for the continuance of pofterity, dries up, and dies, to all appearance confumptive.

To this order of infects we may alfo refer the cuckow spit, or froth worm, that is often found hid in that frothy matter which we find on the furface of plants. It has an oblong, obtufe body ; and a large head, with fmall eyes. The external wings, for it has four, are of a dusky brown colour, marked with two white fspots ; the head is black. The fpume in which it is found wallowing, is all of its own formation, and very much refembles frothy fpittle. It proceeds from the vent of the animal, and other parts of the body ; and if it be wiped away, a new quantity will be quickly feen ejefted from the little animal's body. Within this fpume it is feen in time to acquire four tubercles on its back, wherein the wings are enclosed ; thefe burfting from a reptile, it becomes a winged animal ; and thus rendered perfect, it flies to meet its mate, and propagate its kind.

The water tipula alfo belongs to this clafs. It has an oblong flender body, with four feet fixed upon the breaft, and four feelers near the mouth. It has four weak wings, which do not at all feem proper for flying, but leaping only. But what this infect chiefly demands our attention for is, the wonderful lightnefs wherewith it runs on the furface of the water, fo as fcarcely to put it in motion. It is fometimes feen in ri-

* Swammerdam, p. 114.

vers and on their banks, especially under shady trees; and generally in swarms of several together.

The common water-fly also breeds in the same manner with those above mentioned. This animal is by some called the *notonecta*, because it does not swim, in the usual manner, upon its belly, but on its back: nor can we help admiring that fitness in this insect for its situation, as it feeds on the underside of plants which grow on the surface of the water; and therefore it is thus formed with its mouth upwards, to take its food with greater convenience and ease.

We may also add the water-scorpion, which is a large insect, being near an inch in length, and about half an inch in breadth. Its body is nearly oval, but very flat and thin; and its tail long and pointed. The head is small; and the feelers appear like legs resembling the claws of a scorpion, but without sharp points. This insect is generally found in ponds; and is, of all others, the most tyrannical and rapacious. It destroys, like a wolf among sheep, twenty times as many as its hunger requires. One of these, when put into a basin of water, in which were thirty or forty worms of the *libellula* kind, each as large as itself, destroyed them all in a few minutes; getting on their backs, and piercing with its trunk through their body. These animals, however, though so formidable to others, are nevertheless themselves greatly overrun with a little kind of louse, about the size of a nit, which very probably repays the injury which the water-scorpion inflicts upon others.

The water-scorpions live in the water by day; out of which they rise in the dusk of the evening into the air, and so flying from place to place, often betake themselves, in quest of food, to other waters. The insect, before its wings are grown, remains in the place where it was produced; but when come to its state of perfection, sallies forth in search of a companion of the other sex, in order to continue its noxious posterity.

C H A P. VI.

Of the Ephemera.

THE last insect we shall add to this second order, is the ephemera; which, though not strictly belonging to it, yet seems more properly referred to this rank than any other. Indeed, we must not attend to the rigour of method, in a history where nature seems to take delight to sport in variety.

That there should be a tribe of flies whose duration extends but to a day, seems at first surprizing; but the wonder will increase, when we are told, that some of this kind seem to be born and to die in the space of a single hour. The reptile, however, from which they are bred, is by no means so short lived; but is sometimes seen to live two years, and many times three years together.

All ephemeræ, of which there are various kinds, are produced from the egg, in the form of worms; from whence they change into a more perfect form; namely, that of aurelias, which is a kind of middle state between a worm and a fly; and from thence they take their last mutation, which is into a beautiful fly, of longer or shorter duration, according to its kind.

The ephemera, in its fly state, is a very beautiful winged insect, and has a strong similitude to the butterfly, both from its shape and its wings. It is about the size of a middling butterfly; but its wings differ, in not being covered with the painted dust with which those of butterflies are adorned, and rendered opaque, for they are very transparent and very thin. These insects have four wings, the uppermost of which are much the largest: when the insect is at rest, it generally lays its wings one over the other, on the back. The body is long, being formed of six rings, that are larger at the origin than near the extremity; and from this a tail proceeds, that is lon-

ger than all the rest of the fly, and consists sometimes of three threads of an equal length, or sometimes of two long and one short. To acquire this beautiful form, the insect has been obliged to undergo several transmutations: but its glory is very short lived, for the hour of its perfection is the hour of its death; and it seems scarcely introduced to pleasure, when it is obliged to part with life.

The reptile that is to become a fly, and that is granted so long a term, when compared to its latter duration, is an inhabitant of the water, and bears a very strong resemblance to fishes in many particulars; having gills by which it breathes at the bottom, and also the tapering form of aquatic animals. These insects have six scaly legs, fixed on their corselet. Their head is triangular: the eyes are placed forward, and may be distinguished by their largeness and colour. The mouth is furnished with teeth; and the body consists of six rings; that next the corselet being largest, but growing less and less to the end: the last ring is the shortest, from which the three threads proceed, which are as long as the whole body. Thus we see that the reptile bears a very strong resemblance to the fly; and only requires wings, to be very near its perfection.

As there are several kinds of this animal, their aurelias are consequently of different colours; some yellow, some brown, and some cream-coloured. Some of these also bore themselves cells at the bottom of the water, from which they never stir out, but feed upon the mud composing the walls of their habitation, in contented captivity; others, on the contrary, range about, go from the bottom to the surface, swim between two waters, quit that element entirely to feed upon plants by the river side, and then return to their favourite element, for safety and protection.

The reptile, however, though it lives two or three years, offers but little, in its long duration, to excite curiosity: it is hid at the bottom of the water, and feeds almost wholly within its narrow habitation. The most striking facts command our attention during the short interval of its fly state; into

which it crouds the most various tranſactions of its little life. It then may be ſaid to be in a hurry to live, as it has but ſo ſmall a time to exiſt. The peculiar ſign whereby to know that theſe reptiles will change into flies in a ſhort time, conſiſts in a protuberance of the wings on the back. About that time the ſmooth and depreſſed form of the upper part of the body, is changed into a more ſwollen and rounder ſhape; ſo that the wings are in ſome degree viſible through the external ſheath that covers them. As they are not natives of England, he who would ſee them in the greateſt abundance, muſt walk about ſun-ſet, along the banks of the Rhine, or the Seine, near Paris: where, for about three days, in the miſt of the ſummer, he will be aſtoniſhed at their numbers and aſſiduity. The thickeſt deſcent of the flakes of ſnow in winter ſeem not to equal their number; the whole air ſeems alive with the new-born race; and the earth itſelf is all over covered with their remains. The aurelias, or reptile inſects, that are as yet beneath the ſurface of the water, wait only for the approach of evening to begin their transformation. The moſt induſtrious, ſhake off their old garments about eight o'clock; and thoſe who are the moſt tardy, are transformed before nine.

We have already ſeen that the operation of change in other inſects is laborious and painful; but with theſe, nothing ſeems ſhorter or performed with greater eaſe. The aurelias are ſcarce liſted above the ſurface of the water, than their old ſheathing ſkin burſts; and through the cavity which is thus formed, a fly iſſues, whoſe wings, at the ſame inſtant, are unfolded, and at the ſame time liſt it into the air. Millions and millions of aurelias, riſe in this manner to the ſurface; and at once become flies, and fill every quarter with their flutterings. But all theſe ſports are ſhortly to have an end; for, as the little ſtrangers live but an hour or two, the whole ſwarm ſoon falls to the ground, and covers the earth, like a deep ſnow, for ſeveral hundred yards, on every ſide of the river. Their numbers are then incredible, and every object they touch becomes fatal to them; for they inſtantly die, if they hit againſt each other.

At this time the males and females are very differently employed. The males, quite inactive and apparently without desires, seem only born to die: no way like the males of other insects; they neither follow the opposite sex, nor bear any enmity to each other: after fluttering for an hour or two, they drop upon land, without seeming to receive wings for scarce any other purpose but to satisfy an idle curiosity. It is otherwise with the females, that are scarce risen from the surface of the water, and have dried their wings, but they hasten to drop their eggs back again. If they happen also to flutter upon land, they deposit their burthen in the place where they drop. But then it may be demanded, where and in what manner are these eggs fecundated, as no copulation whatever appears between the sexes in their transitory visits in air? Swammerdam is of opinion, that they are impregnated in the manner of fish-spawn, by the male, after being ejected by the female; but, beside that this doctrine is exploded even from the history of fishes, it is certain, that the males have not time for this operation, as the eggs drop to the bottom the instant they are laid on the water. Reaumur is of opinion that they copulate; but that the act bears a proportion in shortness to the small duration of their lives; and, consequently, must be so soon performed, as to be scarcely visible. This, however, is at best forcing a theory; and, it is probable, that as there are many insects known to breed without any impregnation from the male, as we have already seen in muscles and the oysters, and shall hereafter see in the gnat, and a species of the beetle, so the ephemeræ may be of this number. Be this as it may, the females are in such haste to deposit their eggs, that multitudes of them fall to the ground; but the greatest part are laid in the water. As they flutter upon the surface, two clusters are seen issuing from the extremity of their body, each containing about three hundred and fifty eggs, which make seven hundred in all. Thus, of all insects, this appears to be the most prolific; and it would seem that there was a necessity for such a supply, as, in its reptile state, it is the favourite food of every kind of fresh-water fish. It is in

rain that these little animals form galleries at the bottom of the river, from whence they seldom remove; many kinds of fish break in upon their retreats, and thin their numbers. For this reason, fishermen are careful to provide themselves with these insects, as the most grateful bait; and thus turn the fish's rapacity to its own destruction.

But though the usual date of those flies is two or three hours at farthest, there are some kinds that live several days; and one kind in particular, after quitting the water, has another case or skin to get rid of. These are often seen in the fields and woods, distant from the water: but they are more frequently found in its vicinity. They are often found sticking upon walls and trees; and frequently with the head downwards, without changing place, or having any sensible motion. They are then waiting for the moment when they shall be divested of their last incommodious garment, which sometimes does not happen for two or three days together.

P A R T. III.

C H A P. I.

Of Caterpillars in General.

IF we take a cursory view of insects in general, caterpillars alone, and the butterflies and moths they give birth to, will make a third part of the number. Wherever we move, wherever we turn, these insects, in one shape or another, present themselves to our view. Some, in every state, offer the most entertaining spectacle; others are beautiful only in their winged form. Many persons, of which number I am one, have an invincible aversion to caterpillars, and worms of every species: there is something disagreeable in their slow crawling motion, for which the variety of their colouring can never compensate. But others feel no repugnance at observing, and even handling them with the most attentive application.

There is nothing in the butterfly state, so beautiful or splendid as these insects. They serve, not less than the birds themselves, to banish solitude from our walks, and to fill up our idle intervals with the most pleasing speculations. The butterfly makes one of the principal ornaments of oriental poetry; but, in those countries, the insect is larger and more beautiful than with us.

The beauties of the fly may therefore very well excite our curiosity to examine the reptile. But we are still more strongly attached to this tribe, from the usefulness of one of the number. The silkworm is, perhaps, the most serviceable of all other animals; since, from its labours, and the manufacture attending it, near a third part of the world are clothed, adorned, and supported.

Caterpillars may be easily distinguished from worms or maggots, by the number of their feet ; and by their producing butterflies or moths. When the sun calls up vegetation, and vivifies the various eggs of insects, the caterpillars are the first that are seen, upon almost every vegetable and tree, eating its leaves, and preparing for a state of greater perfection. They have feet both before and behind ; which not only enable them to move forward by a sort of steps made by their fore and hinder parts, but also to climb up vegetables, and to stretch themselves out from the boughs and stalks, to reach their food at a distance. All of this class have from eight feet at the least, to sixteen ; and this may serve to distinguish them from the worm tribe, that never have so many. The animal into which they are converted, is always a butterfly or a moth ; and these are always distinguished from other flies, by having their wings covered over with a painted dust, which gives them such various beauty. The wings of flies are transparent, as we see in the common flesh fly ; while those of beetles are hard, like horn : from such the wing of a butterfly may be easily distinguished ; and words would obscure their differences.

From hence it appears, that caterpillars, whether in the reptile state, or advanced to their last state of perfection into butterflies, may easily be distinguished from all other insects ; being animals peculiarly formed, and also of a peculiar nature. The transmutations they undergo, are also more numerous than those of any insect hitherto mentioned ; and, in consequence, they have been placed in the third order of changes by Swammerdam, who has thrown such lights upon this part of natural history. In the second order of changes, mentioned before, we saw the grasshopper and the earwig, when excluded from the egg, assume a form very like that which they were after to preserve ; and seemed arrived at a state of perfection, in all respects, except in not having wings ; which did not bud forth until they were come to maturity. But the insects of this third order, that we are now about to describe, go through a much greater variety of transformations : for, when they are excluded from the egg, they assume the form of a small

caterpillar, which feeds and grows larger every day, often changing its skin, but still preserving its form. When the animal has come to a certain magnitude in this state, it discontinues eating, makes itself a covering or husk, in which it remains wrapped up, seemingly without life or motion; and after having for some time continued in this state, it once more bursts its confinement, and comes forth a beautiful butterfly. Thus, we see this animal put on no less than three different appearances, from the time it is first excluded from the egg. It appears a crawling caterpillar; then an insensible aurelia, as it is called, without life or motion; and lastly, a butterfly, variously painted, according to its different kind. Having thus distinguished this class of insects from all others, we will first survey their history in general; and then enter particularly into the manners and nature of a few of them, which most deserve our curiosity and attention.

C H A P. II.

Of the Transformation of the Caterpillar into its corresponding Butterfly or Moth.

WHEN winter has disrobed the trees of their leaves, nature then seems to have lost her insects. There are thousands of different kinds, with and without wings; which, though swarming at other seasons, then entirely disappear. Our fields are re-peopled, when the leaves begin to bud, by the genial influence of spring; and caterpillars, of various sorts, are seen feeding upon the promise of the year, even before the leaves are completely unfolded. Those caterpillars, which we then see, may serve to give us a view of the general means which nature employs to preserve such a number of insects during that season, when they can no longer find subsistence. It is known, by united experience, that all

these animals are hatched from the eggs of butterflies; and those who observe them more closely, will find the fly very careful in depositing its eggs in those places where they are likely to be hatched with the greatest safety and success. During winter, therefore, the greatest number of caterpillars are in an egg state; and in this lifeless situation, brave all the rigours and the humidity of the climate: and though often exposed to all its changes, still preserve the latent principles of life, which is more fully exerted at the approach of spring. That same power that pushes forth the budding leaf, and the opening flower, impels the insect into animation; and nature at once seems to furnish the guest and the banquet. When the insect has found force to break its shell, it always finds its favourite aliment provided in abundance before it.

But all caterpillars are not sent off from the egg in the beginning of spring; for many of them have subsisted during the winter in their aurelia state: in which, as we have briefly observed above, the animal is seemingly deprived of life and motion. In this state of insensibility, many of these insects continue during the rigours of winter; some enclosed in a kind of shell, which they have spun for themselves at the end of autumn; some concealed under the bark of trees; others in the chinks of old walls; and many buried under ground. From all these, a variety of butterflies are seen to issue, in the beginning of spring; and adorn the earliest part of the year with their painted flutterings.

Some caterpillars do not make any change whatsoever at the approach of winter, but continue to live in their reptile state, through all the severity of the season. These choose themselves some retreat, where they may remain undisturbed for some months together; and there they continue, quite motionless, and as insensible as if they were actually dead. Their constitution is such, that food, at that time, would be useless; and the cold prevents their making those dissipations which require restoration. In general, caterpillars of this kind are found in great numbers together, enclosed in one common

web, that covers them all, and serves to protect them from the injuries of the air.

Lastly, there are some of the caterpillar kind, whose butterflies live all the winter; and who, having fluttered about some part of the latter end of autumn, seek for some retreat during the winter, in order to answer the ends of propagation, at the approach of spring. These are often found lifeless and motionless in the hollows of trees, or the clefts of timber; but, by being approached to the fire, they recover life and activity, and seem to anticipate the desires of spring.

In general, however, whether the animal has subsisted in an egg state, during the winter; or whether, as a butterfly, bred from an aurelia, in the beginning of spring; or a butterfly that has subsisted during the winter, and lays eggs as soon as the leaves of plants are shot forward, the whole swarm of caterpillars are in motion to share the banquet that nature has provided. There is scarce a plant that has not its own peculiar insects; and some are known to support several of different kinds. Of these, many are hatched from the egg, at the foot of the tree, and climb up to its leaves for subsistence: the eggs of others, have been glued by the parent butterfly to the leaves: and they are no sooner excluded from the shell, but they find themselves in the midst of plenty.

When the caterpillar first bursts from the egg, it is small and feeble; its appetites are in proportion to its size, and it seems to make no great consumption: but as it increases in magnitude, it improves in its appetites; so that, in its adult caterpillar state, it is the most ravenous of all animals whatsoever. A single caterpillar will eat double its own weight of leaves in a day, and yet seems no way disordered by the meal. What would mankind do, if their oxen or their horses were so voracious?

These voracious habits, with its slow crawling motion, but still more a stinging, like that of nettles, which follows upon handling the greatest number of them, make these insects not

the most agreeable objects of human curiosity. However, there are many philosophers who have spent years in their contemplation; and who have not only attended to their habits and labours, but minutely examined their structure and internal conformation.

The body of the caterpillar, when anatomically considered, is found composed of rings, whose circumference is pretty near circular or oval. They are generally twelve in number, and are all membranous; by which caterpillars may be distinguished from many other insects, that nearly resemble them in form. The head of the caterpillar is connected to the first ring by the neck; that is generally so short and contracted, that it is scarce visible. All the covering of the head in caterpillars seems to consist of a shell; and they have neither upper nor under jaw, for they are both placed rather vertically, and each jaw armed with a large thick tooth, which is singly equal to numbers. With these the animals devour their food in such amazing quantities; and with these, some of the kind defend themselves against their enemies. Though the mouth be kept shut, the teeth are always uncovered; and while the insect is in health, they are seldom without employment. Whatever the caterpillar devours, these teeth serve to chop it into small pieces, and render the parts of the leaf fit for swallowing. Many kinds, while they are yet young, eat only the succulent part of the leaf, and leave all the fibres untouched; others, however, attack the whole leaf, and eat it clean away. One may be amused, for a little time, in observing the avidity with which they are seen to feed; some are seen eating the whole day; others have their hours of repast; some choose the night, and others the day. When the caterpillar attacks a leaf, it places its body in such a manner that the edge of the leaf shall fall between its feet, which keeps it steady, while the teeth are employed in cutting it: these fall upon the leaf, somewhat in the manner of a pair of gardener's sheers; and every morsel is swallowed as soon as cut. Some caterpillars feed upon leaves so very narrow, that they are not broader than their

mouths; in this case the animal is seen to devour it from the point, as we would eat a radish.

As there are various kinds of caterpillars, the number of their feet are various; some having eight, and some sixteen. Of these feet, the six foremost are covered with a sort of shining gristle; and are therefore, called the shelly legs. The hindmost feet, whatever be their number, are soft and flexible, and are called membranaceous. Caterpillars also, with regard to their external figure, are either smooth, or hairy. The skin of the first kind is soft to the touch, or hard, like shagreen; the skin of the latter, is hairy, and, as it were, thorny; and generally, if handled, stings like nettles. Some of them even cause this stinging pain, if but approached too nearly.

Caterpillars, in general, have six small black spots placed on the circumference of the fore ring, and a little to the side of the head. Three of these are larger than the rest, and are convex and transparent: these Reaumur takes to be the eyes of the caterpillar; however, most of these reptiles have very little occasion for sight, and seem only to be directed by their feeling.

But the parts of the caterpillar's body, which most justly demand our attention, are the stigmata, as they are called; or those holes on the sides of its body, through which the animal is supposed to breathe. All along this insect's body, on each side, these holes are easily discoverable. They are eighteen in number, nine on a side, rather nearer the belly than the back; a hole for every ring, of which the animal's body is composed, except the second, the third, and the last. These oval openings may be considered as so many mouths, through which the insect breathes; but with this difference, that as we have but one pair of lungs, the caterpillar has no less than eighteen. It requires no great anatomical dexterity to discover these lungs in the larger kind of caterpillars: they appear, at first view, to be hollow cartilaginous tubes, and of the colour of mother-of-pearl. These tubes are often seen to unite with each other; some are perceived to open into the intestines;

and some go to different parts of the surface of the body. That these vessels serve to convey the air, appears evidently, from the famous experiment of Malpighi; who, by stopping up the mouths of the stigmata with oil, quickly suffocated the animal, which was seen to die convulsed the instant after. In order to ascertain his theory, he rubbed oil upon other parts of the insect's body, leaving the stigmata free; and this seemed to have no effect upon the animal's health, but it continued to move and eat as usual: he rubbed oil on the stigmata of one side, and the animal underwent a partial convulsion, but recovered soon after. However, it ought to be observed, that air is not so necessary to these as to the nobler ranks of animals, since caterpillars will live in an exhausted receiver for several days together; and though they seem dead at the bottom, yet, when taken out, recover, and resume their former vivacity.

If the caterpillar be cut open longitudinally along the back, its intestines will be perceived running directly in a straight line from the mouth to the anus. They resemble a number of small bags opening into each other; and strengthened on both sides by a fleshy cord, by which they are united. These insects are, upon many occasions, seen to cast forth the internal coat of their intestines with their food, in the changes which they so frequently undergo. But the intestines take up but a small part of the animal's body, if compared to the fatty substance in which they are involved. This substance changes its colour when the insect's metamorphosis begins to approach; and from white, it is usually seen to become yellow. If to these parts, we add the caterpillar's implements for spinning, (for all caterpillars spin at one time or another) we shall have a rude sketch of this animal's conformation: however, we shall reserve the description of those parts, till we come to the history of the silk-worm, where the manner in which these insects spin their webs, will most properly find place.

The life of a caterpillar seems one continued succession of changes; and it is seen to throw off one skin only to assume

another ; which also is divested in its turn : and thus for eight or ten times successively. We must not, however, confound this changing of the skin with the great metamorphosis which it is afterwards to undergo. The throwing off one skin, and assuming another, seems, in comparison, but a slight operation among these animals : this is but the work of a day ; the other is the great adventure of their lives. Indeed, this faculty of changing the skin, is not peculiar to caterpillars only, but is common to all the insect kind ; and even to some animals that claim a higher rank in nature. We have already seen the lobster and the crab out-growing their first shells, and then bursting from their confinement, in order to assume a covering more roomy and convenient. It is probable that the louse, the flea, and the spider, change their covering from the same necessity ; and growing too large for the crust in which they have been for some time enclosed, burst it for another. This period is probably that of their growth, for as soon as their new skin is hardened round them, the animal's growth is necessarily circumscribed, while it remains within it. With respect to caterpillars, many of them change their skins five or six times in a season ; and this covering, when cast off, often seems so complete, that many might mistake the empty skin for the real insect. Among the hairy caterpillars, for instance, the cast skin is covered with hair ; the feet, as well gristly as membranous, remain fixed to it ; even the parts which nothing but a microscope can discover, are visible in it ; in short, all the parts of the head ; not only the skull, but the teeth.

In proportion as the time approaches in which the caterpillar is to cast its old skin, its colours become more feeble, the skin seems to wither and grow dry, and, in some measure, resembles a leaf, when it is no longer supplied with moisture from the stock. At that time, the insect begins to find itself under a necessity of changing ; and it is not effected without violent labour, and perhaps pain. A day or two before the critical hour approaches, the insect ceases to eat, loses its usual activity, and seems to rest immoveable. It seeks some place

to remain in security ; and no longer timorous, seems regardless even of the touch. It is now and then seen to bend itself and elevate its back ; again it stretches to its utmost extent : it sometimes lifts up the head, and then lets it fall again ; it sometimes waves it three or four times from side to side, and then remains in quiet. At length, some of the rings of its body, particularly the first and second, are seen to swell considerably, the old skin distends and bursts, till, by repeated swellings, and contractions in every ring, the animal disengages itself, and creeps from its inconvenient covering.

How laborious soever this operation may be, it is performed in the space of a minute ; and the animal, having thrown off its old skin, seems to enjoy new vigour, as well as acquired colouring and beauty. Sometimes it happens, that it takes a new appearance, and colours very different from the old. Those that are hairy, still preserve their covering ; although their ancient skin seems not to have lost a single hair : every hair appears to have been drawn, like a sword from the scabbard. However, the fact is, that a new crop of hair grows between the old skin and the new, and probably helps to throw off the external covering.

The caterpillar having in this manner continued for several days feeding, and at intervals casting its skin, begins at last to prepare for its change into an aurelia. It is most probable that, from the beginning, all the parts of the butterfly lay hid in this insect, in its reptile state ; but it required time to bring them to perfection ; and a large quantity of food, to enable the animal to undergo all the changes requisite for throwing off these skins, which seemed to clog the butterfly form. However, when the caterpillar has fed sufficiently, and the parts of the future butterfly have formed themselves beneath its skin, it is then time for it to make its first great and principal change into an aurelia, or a crysalis, as some have chosen to call it ; during which, as was observed, it seems to remain for several days, or even months, without life or motion.

Preparatory to this important change, the caterpillar most

usually quits the plant, or the tree on which it fed ; or at least attaches itself to the stalk or the stem, more gladly than the leaves. It forsakes its food, and prepares, by fasting, to undergo its transmutation. In this period, all the food it has taken is thoroughly digested ; and it often voids even the internal membrane which lined its intestines. Some of this tribe, at this period also, are seen entirely to change colour ; and the vivacity of the tints in all, seems faded. Those of them which are capable of spinning themselves a web, set about this operation ; those which have already spun, await the change in the best manner they are able. The web or cone, with which some cover themselves, hides the aurelia contained within from the view ; but in others, where it is more transparent, the caterpillar, when it has done spinning, strikes into it the claws of the two feet under the tail, and afterwards forces in the tail itself, by contracting those claws, and violently striking the feet one against the other. If, however, they may be taken from their web at this time, they appear in a state of great langour ; and, incapable of walking, remain on that spot where they are placed. In this condition, they remain one or two days, preparing to change into an aurelia ; somewhat in the manner they made preparations for changing their skin. They then appear with their bodies bent into a bow, which they now and then are seen to straiten : they make no use of their legs ; but if they attempt to change place, do it by the contortions of their body. In proportion as their change into an aurelia approaches, their body becomes more and more bent ; while their extensions and convulsive contractions become more frequent. The hinder end of the body is the part which the animal first disengages from its caterpillar skin ; that part of the skin remains empty, while the body is drawn up contractedly towards the head. In the same manner they disengage themselves from the two succeeding rings ; so that the animal is then lodged entirely in the fore-part of its caterpillar covering : that half which is abandoned, remains flaccid and empty ; while the fore-part, on the contrary, is swollen and distended. The animal, having thus quitted the

hinder part of its skin, to drive itself up into the fore-part, still continues to heave and work as before; so that the skull is soon seen to burst into three pieces, and a longitudinal opening is made in the three first rings of the body, through which the insect thrusts forth its naked body, with strong efforts. Thus, at last, it entirely gets free from its caterpillar skin, and for ever forsakes its most odious reptile form.

The caterpillar, thus stripped of its skin for the last time, is now become an aurelia; in which the parts of the future butterfly are all visible; but in so soft a state, that the smallest touch can discompose them. The animal is now become helpless and motionless; but only waits for the assistance of the air to dry up the moisture on its surface, and supply it with a crust capable of resisting external injuries. Immediately after being stripped of its caterpillar skin, it is of a green colour, especially in those parts which are distended by an extraordinary afflux of animal moisture; but in ten or twelve hours after being thus exposed, its parts harden, the air forms its external covering into a firm crust, and in about four and twenty hours, the aurelia may be handled without endangering the little animal that is thus left in so defenceless a situation. Such is the history of the little pod or cone that is found so common by every path-way, sticking to nettles, and sometimes shining like polished gold. From the beautiful and resplendent colour, with which it is thus sometimes adorned, some authors have called it a crysalis, implying a creature made of gold.

Such are the efforts by which these little animals prepare for a state of perfection; but their care is still greater to provide themselves a secure retreat, during this season of their imbecility. It would seem like erecting themselves a monument, where they were to rest secure, until nature had called them into a new and more improved existence. For this purpose, some spin themselves a cone or web, in which they lie secure till they have arrived at maturity: others, that cannot spin so copious a covering, suspend themselves by the tail, in some retreat where they are not likely to meet disturbances. Some.

mix sand with their gummy and moist webs, and thus make themselves a secure incrustation ; while others, before their change, bury themselves in the ground, and thus avoid the numerous dangers that might attend them. One would imagine that they were conscious of the precise time of their continuance in their aurelia state; since their little sepulchres, with respect to the solidity of the building, are proportioned to such duration. Those that are to lie in that state of existence but a few days, make choice of some tender leaf, which they render still more pliant by diffusing a kind of glue upon it: the leaf thus gradually curls up, and withering as it enfolds, the insect wraps itself within, as in a mantle, till the genial warmth of the sun enables it to struggle for new life, and burst from its confinement. Others, whose time of transformation is also near at hand, fasten their tails to a tree, or to the first worm-hole they meet, in a beam, and wait in that defenceless situation. Such caterpillars, on the other hand, as are seen to live several months in their aurelia state, act with much greater circumspection. Most of them mix their web with sand, and thus make themselves a strong covering: others build in wood, which serves them in the nature of a coffin. Such as have made the leaves of willows their favourite food, break the tender twigs of them first into small pieces, then pound them as it were to powder: and, by means of their glutinous silk, make a kind of paste in which they wrap themselves up. Many are the forms which these animals assume in this helpless state; and it often happens, that the most deformed butterflies issue from the most beautiful aurelias.

In general, however, the aurelia takes the rude outline of the parts of the animal which is contained within it; but as to the various colours which it is seen to assume, they are rather the effect of accident; for the same species of insect does not at all times assume the same hue, when it becomes an aurelia. In some, the beautiful gold colour is at one time found; in others, it is wanting. This brilliant hue, which does not fall short of the best gilding, is formed in the same manner in which we see leather obtain a gold colour, though

none of that metal ever enters into the tincture. It is only formed by a beautiful brown varnish, laid upon a white ground; and the white thus gleaming through the transparency of the brown, gives a charming golden yellow. These two colours are found, one over the other, in the aurelia of the little animal we are describing; and the whole appears gilded, without any real gilding.

The aurelia thus formed, and left to time to expand into a butterfly, in some measure resembles an animal in an egg, that is to wait for external warmth to hatch it into life and vigour. As the quantity of moisture that is enclosed within the covering of the aurelia, continues to keep its body in the most tender state, so it is requisite that this humidity should be dried away, before the little butterfly can burst its prison. Many have been the experiments to prove, that nature may, in this respect, be assisted by art; and that the life of the insect may be retarded or quickened, without doing it the smallest injury. For this purpose, it is only requisite to continue the insect in its aurelia state, by preventing the evaporation of its humidity; which will consequently add some days, nay weeks, to its life: on the other hand, by evaporating its moisture, in a warm situation, the animal assumes its winged state before its usual time, and goes through the offices assigned its existence. To prove this, mr. Reaumur enclosed the aurelia in a glass tube; and found the evaporated water, which exhaled from the body of the insect, collected in drops at the bottom of the tube: he covered the aurelia with varnish; and this making the evaporation more difficult and slow, the butterfly was two months longer than its natural term, in coming out of its case; he found, on the other hand, that, by laying the animal in a warm room, he hastened the disclosure of the butterfly; and by keeping it in an ice-house, in the same manner, he delayed it. Warmth acted, in this case, in a double capacity; invigorating the animal, and evaporating the moisture.

The aurelia, though it bears a different external appearance, nevertheless, contains within it all the parts of the but-

terfly in perfect formation ; and lying each in a very orderly manner, though in the smallest compass. These, however, are so fast and tender, that it is impossible to visit without discomposing them. When either by warmth, or increasing vigour, the parts have acquired the necessary force and solidity, the butterfly then seeks to disembarrafs itself of those bands which kept it so long in confinement. Some insects continue under the form of an aurelia not above ten days; some twenty; some several months; and even for a year together.

The butterfly, however, does not continue so long under the form of an aurelia, as one would be apt to imagine. In general, those caterpillars that provide themselves with cones, continue within them but a few days after the cone is completely finished. Some, however, remain buried in this artificial covering for eight or nine months, without taking the smallest sustenance during the whole time : and though in the caterpillar state, no animals were so voracious, when thus transformed, they appear a miracle of abstinence. In all, sooner or later, the butterfly bursts from its prison ; not only that natural prison which is formed by the skin of the aurelia, but also from that artificial one of silk, or any other substance in which it has enclosed itself.

The efforts which the butterfly makes to get free from its aurelia state, are by no means so violent, as those which the insect had in changing from the caterpillar into the aurelia. The quantity of moisture surrounding the butterfly is by no means so great as that attending its former change ; and the shell of the aurelia is so dry, that it may be cracked between the fingers.

If the animal be shut up within a cone, the butterfly always gets rid of the natural internal skin of the aurelia, before it eats its way through the external covering which its own industry has formed round it. In order to observe the manner, in which it thus gets rid of the aurelia covering, we must cut open the cone, and then we shall have an opportunity of discovering the insect's efforts to emancipate itself from its na-

tural shell. When this operation begins, there seems to be a violent agitation in the humours contained within the little animal's body. Its fluids seem driven, by an hasty fermentation, through all the vessels; while it labours violently with its legs, and makes several other violent struggles to get free. As all these motions concur with the growth of the insect's wings and body, it is impossible that the brittle skin which covers it should longer resist: it at length gives way, by bursting into four distinct and regular pieces. The skin of the head and legs first separates; then the skin at the back flies open, and dividing into two regular portions, disengages the back and wings: then there likewise happens another rupture in that portion which covered the rings of the back of the aurelia. After this, the butterfly, as if fatigued with its struggles, remains very quiet for some time, with its wings pointed downwards, and its legs fixed in the skin which it had just thrown off. At first sight, the animal, just set free, and permitted the future use of its wings, seems to want them entirely: they take up such little room, that one would wonder where they were hidden. But soon after, they expand so rapidly, that the eye can scarce attend their unfolding. From reaching scarce half the length of the body, they acquire, in a most wonderful manner, their full extent and bigness, so as to be each five times larger than they were before. Nor is it the wings alone that are thus increased: all their spots and paintings, before so minute as to be scarce discernible, are proportionably extended; so that, what a few minutes before seemed only a number of confused, unmeaning points, now become distinct and most beautiful ornaments. Nor are the wings, when they are thus expanded, unfolded in the manner in which earwigs and grasshoppers display theirs, who unfurl them like a lady's fan: on the contrary, those of butterflies actually grow to their natural size in this very short space. The wing, at the instant it is freed from its late confinement, is considerably thicker than afterwards; so that it spreads in all its dimensions, growing thinner as it becomes broader. If one of the wings be plucked from the animal just set free, it may be

spread by the fingers, and it will soon become as broad as the other, which has been left behind. As the wings extend themselves so suddenly, they have not yet had time to dry; and accordingly appear like pieces of wet paper, soft, and full of wrinkles. In about half an hour, they are perfectly dry, their wrinkles entirely disappear, and the little animal assumes all its splendour. The transmutation being thus perfectly finished, the butterfly discharges three or four drops of a blood-coloured liquid, which are the last remains of its superfluous moisture. Those aurelias which are enclosed within a cone, find their exit still more difficult, as they have still another prison to break through: this, however, they perform in a short time; for the butterfly, freed from its aurelia skin, butts with its head violently against the walls of its artificial prison; and probably with its eyes, that are rough and like a file, it rubs the internal surface away; till it is at last seen bursting its way into open light; and, in less than a quarter of an hour, the animal acquires its full perfection.

Thus, to use the words of Swammerdam, we see a little insignificant creature distinguished, in its last birth, with qualifications and ornaments, which man, during his stay upon earth, can never even hope to acquire. The butterfly, to enjoy life, needs no other food but the dews of heaven; and the honeyed juices which are distilled from every flower. The pageantry of princes cannot equal the ornaments with which it is invested; nor the rich colouring that embellishes its wings. The skies are the butterfly's proper habitation, and the air its element: whilst man comes into the world naked, and often roves about without habitation or shelter; exposed, on one hand, to the heat of the sun; and on the other, to the damps and exhalations of the earth; both alike enemies of his happiness and existence.—A strong proof that, while this little animal is raised to its greatest height, we are as yet, in this world, only candidates for perfection!

C H A P. III.

Of Butterflies and Moths.

IT has been already shown that all butterflies are bred from caterpillars; and we have exhibited the various circumstances of that surprizing change. It has been remarked, that butterflies may be easily distinguished from flies of every other kind, by their wings; for, in others, they are either transparent, like gauze, as we see in the common flesh fly; or they are hard and crufted, as we see in the wings of the beetle. But in the butterfly, the wings are soft, opake, and painted over with a beautiful duft, that comes off with handling.

The number of these beautiful animals is very great; and though Linnæus has reckoned up above seven hundred and fixty different kinds, the catalogue is still very incomplete. every collector of butterflies can show undescribed species: and such as are fond of minute discovery, can here produce animals that have been examined only by himself. In general, however, those of the warm climates, are larger and more beautiful than such as are bred at home; and we can easily admit the beauty of the butterfly, since we are thus freed from the damage of the caterpillar. It has been the amusement of some to collect these animals, from different parts of the world; or to breed them from caterpillars at home. These they arrange in systematic order; or dispose so as to make striking and agreeable pictures: and all must grant, that this specious idleness is preferable to that unhappy state which is produced by a total want of employment.

The wings of butterflies, as was observed, fully distinguish them from flies of every other kind. They are four in number; and though two of them be cut off, the animal can fly with two others remaining. They are, in their own substance, transparent; but owe their opacity to their beautiful duft.

with which they are covered ; and which has been likened, by some naturalists, to the feathers of birds ; by others, to the scales of fishes ; as their imaginations were disposed to catch the resemblance. In fact, if we regard the wing of a butterfly with a good microscope, we shall perceive it studded over with a variety of little grains of different dimensions and forms, generally supported upon a footstalk, regularly laid upon the whole surface. Nothing can exceed the beautiful and regular arrangement of these little substances ; which thus serve to paint the butterfly's wing. Like the tiles of a house, those of one rank are a little covered by those that follow : they are of many figures : on one part of the wing may be seen a succession of oval studs ; on another part, a cluster of studs, each in a form of a heart : in one place they resemble a hand open ; and in another they are long or triangular ; while all are interspersed with taller studs, that grow between the rest, like mushrooms upon a stalk. The wing itself is composed of several thick nerves, which render the construction very strong, though light ; and though it be covered over with thousands of these scales or studs, yet its weight is very little increased by the number. The animal is with ease enabled to support itself a long while in air, although its flight be not very graceful. When it designs to fly to a considerable distance, it ascends and descends alternately ; going sometimes to the right, sometimes to the left, without any apparent reason. Upon closer examination, however, it will be found that it flies thus irregularly in pursuit of its mate ; and as dogs bait and quarter the ground in pursuit of their game, so these insects traverse the air, in quest of their mates, whom they can discover at more than a mile's distance.

If we prosecute our description of the butterfly, the animal may be divided into three parts ; the head, the thorax, and the body.

The body is the hinder-part of the butterfly, and is composed of rings which are generally concealed under long hair,

with which that part of the animal is clothed. The corselet is more solid than the rest of the body, because the fore wings and the legs, are fixed therein. The legs are six in number, although four only are made use of by the animal; the two fore legs being often so much concealed in the long hair of the body, that it is sometimes difficult to discover them. If we examine these parts internally, we shall find the same set of vessels in the butterfly that we observed in the caterpillar, but with this great difference, that as the blood, or humours, in the caterpillar, circulated from the tail to the head, they are found, in the butterfly, to take a direct contrary course, and to circulate from the head to the tail; so that the caterpillar may be considered as the embryo animal, in which, as we have formerly seen, the circulation is carried on differently from what it is in animals when excluded.

But leaving the other parts of the butterfly, let us turn our attention particularly to the head. The eyes of butterflies have not all the same form; for, in some they are large, in others small; in some they are the larger portion of a sphere, in others they are but a small part of it, and just appearing from the head. In all of them, however, the outward coat has a lustre, in which may be discovered the various colours of the rainbow. When examined a little closely, it will be found to have the appearance of a multiplying glass; having a great number of sides, or facets, in the manner of a brilliant cut diamond. In this particular, the eye of the butterfly, and of most other insects, entirely correspond; and Luenhoek pretends, there are above six thousand facets on the cornea of a flea. These animals, therefore, see not only with great clearness, but view every object multiplied in a surprizing manner. Puget adapted the cornea of a fly in such a position, as to see objects through it by the means of a microscope; and nothing could exceed the strangeness of its representations: a soldier, who was seen through it, appeared like an army of pigmies; for while it multiplied, it also diminished the object: the arch of a bridge exhibited a spectacle more magnificent than human skill could perform; the flame of a candle seemed

a beautiful illumination. It still, however, remains a doubt, whether the insect sees objects singly, as with one eye; or whether every facet is itself a complete eye, exhibiting its own object distinct from all the rest.

Butterflies, as well as most other flying insects, have two instruments, like horns, on their heads, which are commonly called feelers. They differ from the horns of greater animals, in being moveable at their base; and in having a great number of joints, by which means the insect is enabled to turn them in every direction. Those of butterflies are placed at the top of the head, pretty near the external edge of each eye. What the use of these instruments may be, which are thus formed with so much art, and by a workman who does nothing without reason, is as yet unknown to man. They may serve to guard the eye; they may be of use to clean it; or they may be the organ of some sense which we are ignorant of: but this is only explaining one difficulty by another.

We are not so ignorant of the uses of the trunk, which few insects of the butterfly kind are without. This instrument is placed exactly between the eyes; and when the animal is not employed in seeking its nourishment, it is rolled up, like a curl. A butterfly, when it is feeding, flies round some flower, and settles upon it. The trunk is then uncurled, and thrust out either wholly or in part: and is employed in searching the flower to its very bottom, let it be ever so deep. This search being repeated seven or eight times, the butterfly then passes to another; and continues to hover over those agreeable to its taste, like a bird over its prey. This trunk consists of two equal hollow tubes, nicely joined to each other, like the pipes of an organ.

Such is the figure and conformation of these beautiful insects, that cheer our walks, and gives us the earliest intimations of summer. But it is not by day alone that they are seen fluttering wantonly from flower to flower, as the greatest number of them fly by night, and expand the most beautiful colouring, at those hours when there is no spectator. This

tribe of insects has therefore been divided into diurnal and nocturnal flies ; or, more properly speaking, into butterflies and moths : the one only flying by day, the other most usually on the wing in the night. They may be easily distinguished from each other, by their horns or feelers : those of the butterfly being clubbed, or knobbed at the end ; those of the moth, tapering finer and finer to a point. To express it technically—the feelers of butterflies are clavated ; those of moths are filiform.

The butterflies, as well as the moths, employ the short life assigned them, in a variety of enjoyments. Their whole time is spent either in quest of food, which every flower offers ; or in pursuit of the female, whose approach they can often perceive at a very great distance. Their sagacity in this particular is not less astonishing than true ; but by what sense they are thus capable of distinguishing each other at such distances, is not easy to conceive. It cannot be by the sight, since such small objects as they are, must be utterly imperceptible, at half the distance at which they perceive each other : it can scarcely be by the sense of smelling, since the animal has no organs for that purpose. Whatever be their powers of perception, certain it is, that the male, after having fluttered, as if carelessly, about for some time, is seen to take wing, and go forward, sometimes for two miles together, in a direct line to where the female is perched on a flower.

The general rule among insects is, that the female is larger than the male ; and this obtains particularly in the tribe I am describing. The body of the male is smaller and slenderer ; that of the female, more thick and oval. Previous to the junction of these animals, they are seen sporting in the air, pursuing and flying from each other, and preparing, by a mock combat, for the more important business of their lives. If they be disturbed while united, the female flies off with the male on her back, who seems entirely passive upon the occasion.

But the females of many moths, and butterflies, seem to

have assumed their airy form for no other reason but to fecundate their eggs, and lay them. They are not seen fluttering about in quest of food, or a mate: all that passes, during their short lives, is a junction with the male of about half an hour; after which they deposit their eggs, and die without taking any nourishment, or seeking any. It may be observed, however, that in all the females of this tribe, they are impregnated by the male by one aperture, and lay their eggs by another.

The eggs of female butterflies are disposed in the body like a bed of chaplets; which, when excluded, are usually oval, and of a whitish colour: some, however, are quite round; and others flatted, like a turnip. The covering or shell of the egg, though solid, is thin and transparent; and in proportion as the caterpillar grows within the egg, the colours change, and are distributed differently. The butterfly seems very well instructed by nature in its choice of the plant, or the leaf, where it shall deposit its burthen. Each egg contains but one caterpillar; and it is requisite that this little animal, when excluded, should be near its peculiar provision. The butterfly, therefore, is careful to place her brood only upon those plants that afford good nourishment to its posterity. Though the little winged animal has been fed itself upon dew, or the honey of flowers, yet it makes choice for its young of a very different provision, and lays its eggs on the most unfavourable plants; the ragweed, the cabbage, or the nettle. Thus, every butterfly chooses not the plant most grateful to it in its winged state; but such as it has fed upon in its reptile form.

All the eggs of butterflies are attached to the leaves of the favourite plant, by a sort of size or glue; where they continue, unobserved, unless carefully sought after. The eggs are sometimes placed round the tender shoots of plants, in the form of bracelets, consisting of above two hundred in each, and generally surrounding the shoot, like a ring upon the finger. Some butterflies secure their eggs from the injuries of air, by covering them with hair, plucked from their own bodies, as

birds sometimes are seen to make their nests ; so that their eggs are thus kept warm, and also entirely concealed.

All the tribe of female moths lay their eggs a short time after they leave the aurelia ; but there are many butterflies that flutter about the whole summer, and do not think of laying, till the winter begins to warn them of their approaching end : some even continue the whole winter in the hollows of trees, and do not provide for posterity until the beginning of April, when they leave their retreats, deposit their eggs, and die. Their eggs soon begin to feel the genial influence of the season : the little animals burst from them in their caterpillar state, to become aurelias, and butterflies in their turn ; and thus to continue the round of nature.

C H A P. IV.

Of the Enemies of the Caterpillar.

NATURE, though it has rendered some animals surprisingly fruitful, yet ever takes care to prevent their too great increase. One set of creatures is generally opposed to another : and those are chiefly the most prolific, that are, from their imbecility, incapable of making any effectual defence. The caterpillar has, perhaps, of all other animals, the greatest number of enemies ; and seems only to exist, by its surprising fecundity. Some animals devour them by hundreds ; others, more minute, yet more dangerous, mangle them in various ways : so that, how great soever their numbers may be, their destroyers are in equal proportion. Indeed, if we consider the mischiefs these reptiles are capable of occasioning, and the various damages we sustain from their insatiable rapacity, it is happy for the other ranks of nature, that there are thousands of fishes, birds, and even insects, that live chiefly upon caterpillars, and make them their most favourite repast.

When we described the little birds that live in our gardens, and near our houses, as destructive neighbours, sufficient attention was not paid to the services which they are frequently found to render us. It has been proved, that a single sparrow and its mate, that have young ones, destroy above three thousand caterpillars in a week; not to mention several butterflies, in which numberless caterpillars are destroyed in embryo. It is in pursuit of these reptiles that we are favoured with the visits of many of our most beautiful songsters; that amuse us during their continuance, and leave us when the caterpillars disappear.

The maxim which has often been urged against man, that he, of all other animals, is the only creature that is an enemy to his own kind, and that the human species only are found to destroy each other, has been adopted, by persons who never considered the history of insects. Some of the caterpillar kind in particular, that seem fitted only to live upon leaves and plants, will, however, eat each other; and the strongest will devour the weak, in preference to their vegetable food. That which lives upon the oak, is found to seize any of its companions, which it conveniently can, by the first rings, and inflict a deadly wound: it then feasts in tranquility on its prey, and leaves nothing of the animal but the husk.

But it is not from each other they have most to fear, as in general they are inoffensive; and many of this tribe are found to live in a kind of society. Many kinds of flies lay their eggs either upon, or within their bodies; and as these turn into worms, the caterpillar is seen to nourish a set of intestine enemies within its body, that must shortly be its destruction: nature having taught flies, as well as all other animals, the surest methods of perpetuating their kind. "Towards the end of August," says Reaumur, "I perceived a little fly, of a beautiful gold colour, busily employed in the body of a large caterpillar, of that kind which feeds upon cabbage. I gently separated that part of the leaf, on which these insects were placed, from the rest of the plant, and placed it where I

might observe them more at my ease. The fly, wholly taken up by the business in which it was employed, walked along the caterpillar's body, now and then remaining fixed to a particular spot. Upon this occasion, I perceived it every now and then dart a sting, which it carried at the end of its tail, into the caterpillar's body, and then drew it out again, to repeat the same operation in another place. It was not difficult for me to conjecture the business which engaged this animal so earnestly; its whole aim was to deposit its eggs in the caterpillar's body; which was to serve as a proper retreat for bringing them to perfection. The reptile, thus rudely treated, seemed to bear all very patiently, only moving a little when stung too deeply; which, however, the fly seemed entirely to disregard. I took particular care to feed this caterpillar; which seemed to me to continue as voracious and vigorous as any of the rest of this kind. In about ten or twelve days, it changed into an aurelia, which seemed gradually to decline, and died: upon examining its internal parts, the animal was entirely devoured by worms; which, however, did not come to perfection, as it is probable they had not enough to sustain them within."

What the French philosopher perceived upon this occasion, is every day to be seen in several of the larger kinds of caterpillars, whose bodies serve as a nest to various flies, that very carefully deposit their eggs within them. The large cabbage caterpillar is so subject to its injuries, that, at certain seasons, it is much easier to find them with than without them. The ichneumon fly, as it is called, particularly infests these reptiles, and prevents their fecundity. This fly is, of all others, the most formidable to insects of various kinds. The spider, that destroys the ant, the moth, and the butterfly, yet often falls a prey to the ichneumon; who pursues the robber to his retreat, and, despising his nets, tears him in pieces, in the very labyrinth he has made. This insect, as redoubtable as the little quadruped that destroys the crocodile, has received the same name; and from its destruction of the caterpillar tribe, is probably more serviceable to mankind. This insect, I say, makes

the body of the caterpillar the place for depositing its eggs ; to the number of ten, fifteen, or twenty. As they are laid in those parts which are not mortal, the reptile still continues to live, and to feed, showing no signs of being incommoded by its new guests. The caterpillar changes its skin, and sometimes undergoes the great change into an aurelia : but still the fatal intruders work within, and secretly devour its internal substance : soon after they are seen bursting through its skin, and moving away, in order to spin themselves a covering, previous to their own little transformation. It is, indeed, astonishing sometimes to see the number of worms, and those pretty large, that thus issue from the body of a single caterpillar, and eat their way through its skin : but it is more extraordinary still, that they should remain within the body, devouring its entrails, without destroying its life. The truth is, they seem instructed by nature not to devour its vital parts ; for they are found to feed only upon that fatty substance which composes the largest part of the caterpillar's body. When this surprising appearance was first observed, it was supposed that the animal thus gave birth to a number of flies, different from itself ; and that the same caterpillar sometimes bred an ichneumon, and sometimes a butterfly ; but it was not till after more careful inspection, it was discovered, that the ichneumon tribe were not the caterpillar's offspring, but its murderers.

C H A P. V.

Of the Silkworm.

HAVING mentioned, in the last chapter, the damages inflicted by the caterpillar tribe, we now come to an animal of this kind, that alone compensates for all the mischief occasioned by the rest. This little creature, which only works

for itself, has been made of the utmost service to man; and furnishes him with a covering more beautiful than any other animal can supply. We may declaim indeed against the luxuries of the times, when silk is so generally worn; but were such garments to fail, what other arts could supply their deficiency?

Though silk was anciently brought in small quantities to Rome, yet it was so scarce as to be sold for its weight in gold; and was considered as such a luxurious refinement in dress, that it was infamous for a man to appear in habits of which silk formed but half the composition. It was most probably brought among them from the remotest parts of the east; since it was, at the time of which I am speaking, scarcely known even in Persia.

Nothing can be more remote from the truth, than the manner in which their historians describe the animal by which silk is produced. Pausanius informs us, that silk came from the country of the Seres, a people of Asiatic Scythia; in which place an insect, as large as the beetle, but in every other respect resembling a spider, was bred up for that purpose. They take great care, as he assures us, to feed and defend it from the weather; as well during the summer's heat, as the rigours of winter. This insect, he observes, makes its web with its feet, of which it has eight in number. It is fed, for the space of four years, upon a kind of paste, prepared for it; and at the beginning of the fifth, it is supplied with the leaves of the green willow, of which it is particularly fond. It then feeds till it bursts with fat: after which they take out its bowels, which are spun into the beautiful manufacture so scarce and costly.

The real history of this animal was unknown among the Romans till the times of Justinian; and it is supposed, that silkworms were not brought into Europe till the beginning of the twelfth century; when Roger of Sicily, brought workmen in this manufacture from Asia Minor, after his return from his expedition to the Holy Land, and settled them in

Sicily and Calabria. From these, the other kingdoms of Europe learned this manufacture; and it is now one of the most lucrative carried on among the southern provinces of Europe.

The silkworm is now very well known to be a large caterpillar, of a whitish colour, with twelve feet, and producing a butterfly of the moth kind. The cone on which it spins, is formed for covering it while it continues in the aurelia state; and several of these properly wound off, and united together, form those strong and beautiful threads, which are woven into silk. The feeding these worms, the gathering, the winding, the twisting, and their weaving their silk, is one of the principal manufactures of Europe; and, as our luxuries increase, seems every day to become more and more necessary to human happiness.

There are two methods of breeding silkworms; for they may be left to grow, and remain at liberty upon the trees where they are hatched; or they may be kept in a place built for that purpose, and fed every day with fresh leaves. The first method is used in China, Tonquin, and other hot countries; the other is used in those places where the animal has been artificially propagated, and still continues a stranger. In the warm climates, the silkworm proceeds from an egg, which has been glued by the parent moth upon proper parts of the mulberry-tree, and which remains in that situation during the winter. The manner in which they are situated and fixed to the tree, keeps them unaffected by the influence of the weather; so that those frosts which are severe enough to kill the tree, have no power to injure the silkworm.

The insect never proceeds from the egg till nature has provided it a sufficient supply; and till the budding leaves are furnished, in sufficient abundance, for its support. When the leaves are put forth, the worms seem to feel the genial summons, and bursting from their little eggs, crawl upon the leaves, where they feed with a most voracious appetite. Thus they become larger by degrees; and, after some months' feed-

ing, they lay, upon every leaf, small bundles, or cones of silk, which appear like so many golden apples, painted on a fine green ground. Such is the method of breeding them in the east; and without doubt, it is best for the worms, and least troublesome for the feeder of them. But it is otherwise in our colder European climates; the frequent changes of the weather, and the heavy dews of our evenings, render the keeping them all night exposed, subject to so many inconveniencies, as to admit of no remedy. It is true, that, by the assistance of nets, they may be preserved from the insults of birds; but the severe cold weather, which often succeeds the first heats of summer, as well as the rain and high winds, will destroy them all: and, therefore, to breed them in Europe, they must be sheltered and protected from every external injury.

For this purpose, a room is chosen, with a south aspect; and the windows are so well glazed, as not to admit the least air: the walls are well built, and the planks of the floor exceeding close, so as to admit neither birds nor mice, nor even so much as an insect. In the middle, there should be four pillars erected, or four wooden posts so placed as to form a pretty large square. Between these are different stories made with oser hurdles; and under each hurdle there should be a floor, with an upright border all round. These hurdles and floors must hang upon pulleys, so as to be placed, or taken down at pleasure.

When the worms are hatched, some tender mulberry leaves are provided, and placed in the cloth or paper box in which the eggs were laid, and which are large enough to hold a great number. When they have acquired some strength, they must be distributed on beds of mulberry leaves, in the different stories of the square in the middle of the room, round which a person may freely pass on every side. They will fix themselves to the leaves, and afterwards to the sticks of the hurdles, when the leaves are devoured. They have then a thread, by which they can suspend themselves on occasion, to prevent any shock by a fall; but this is by no means to be considered as

the silk which they spin afterwards in such abundance. Care must be taken that fresh leaves be brought every morning, which must be strewed very gently and equally over them; upon which the silkworms will forsake the remainder of the old leaves, which must be carefully taken away, and every thing kept very clean; for nothing hurts these insects so much as moisture and uncleanness. For this reason their leaves must be gathered when the weather is dry, and kept in a dry place, if it be necessary to lay in a store. As these animals have but a short time to live, they make use of every moment, and almost continually are spinning, except at those intervals when they change their skins. If mulberry leaves be difficult to be obtained, the leaves of lettuce or holyoak will sustain them: but they do not thrive so well upon their new diet; and their silk will neither be so copious, nor of so good a quality.

Though the judicious choice, and careful management of their diet, is absolutely necessary, yet there is another precaution of equal importance, which is to give them air, and open their chamber windows, at such times as the sun shines warmest. The place also must be kept as clean as possible; not only the several floors that are laid to receive their ordure, but the whole apartments in general. These things well observed, contribute greatly to their health and increase.

The worm, at the time it bursts the shell, is extremely small, and of a black colour; but the head is of a more shining black than the rest of the body: some days after, they begin to turn whitish, or of an ash-coloured grey. After the skin begins to grow too rigid, or the animal is stunted within it, the insect throws it off, and appears clothed a-new: it then becomes larger and much whiter, though it has a greenish cast: after some days, which are more or less, according to the different heat of the climate, or to the equality of the food, it leaves off eating, and seems to sleep for two days together: then it begins to stir, and put itself into violent motions, till the skin falls off the second time, and is thrown aside by the animal's feet. All these changes are made in three

weeks or a month's time ; after which it begins to feed once more, still in its caterpillar form, but a good deal differing from itself before its change. In a few days time it seems to sleep again ; and, when it awakes, it again changes its clothing, and continues feeding as before. When it has thus taken a sufficiency of food, and its parts are disposed for assuming the aurelia form, the animal forfakes, for the last time, all food and society, and prepares itself a retreat to defend it from external injuries, while it is seemingly deprived of life and motion.

This retreat is no other than its cone, or ball of filk, which nature has taught it to compose with great art ; and within which it buries itself, till it assumes its winged form. This cone or ball is spun from two little longish kinds of bags that lie above the intestines, and are filled with a gummy fluid, of a marigold colour. This is the substance of which the threads are formed ; and the little animal is furnished with a surprising apparatus for spinning it to the degree of fineness which its occasions may require. This instrument, in some measure, resembles a wire-drawer's machine, in which gold or silver threads are drawn to any degree of minuteness ; and through this the animal draws its thread with great assiduity. As every thread proceeds from two gum bags, it is probable that each supplies its own ; which, however, are united, as they proceed from the animal's body. If we examine the thread with a microscope, it will be found that it is flatted on one side, and grooved along its length : from hence we may infer, that it is doubled just upon leaving the body ; and that the two threads stick to each other by that gummy quality of which they are possessed. Previous to spinning its web, the silkworm seeks out some convenient place to erect its cell, without any obstruction. When it has found a leaf, or a chink fitted to its purpose, it begins to wreath its head in every direction, and fastens its thread on every side to the sides of its retreat. Though all its first essays seem perfectly confused, yet they are not altogether without design : there appears, indeed, no

order or contrivance in the disposal of its first threads ; they are by no means laid artfully over each other, but are thrown out at random, to serve as an external shelter against rain ; for nature having appointed the animal to work upon trees in the open air, its habits remain, though it is brought up in a warm apartment.

Malpighi pretends to have observed six different layers in a single cone of silk : but what may easily be observed is, that it is composed externally of a kind of rough cotton-like substance, which is called floss ; within the thread is more distinct and even ; and next the body of the aurelia, the apartment seems lined with a substance of the hardness of paper, but of a much stronger consistence. It must not be supposed, that the thread which goes to compose the cone, is rolled round, as we roll a bottom ; on the contrary, it lies upon it in a very irregular manner, and winds off now from one side of the cone, and then from the other. This whole thread, if measured, will be found about three hundred yards long ; and so very fine, that eight or ten of them are generally rolled off into one by the manufacturers. The cone, when completed, is in form like a pigeon's egg, and more pointed at one end than the other ; at the smaller end, the head of the aurelia is generally found ; and this is the place that the insect, when converted into a moth, is generally seen to burst through.

It is generally a fortnight or three weeks before the aurelia is changed into a moth ; but no sooner is the winged insect completely formed, than having divested itself of its aurelia skin, it prepares to burst through its cone, or outward prison : for this purpose it extends its head towards the point of the cone, butts with its eyes, which are rough, against the lining of its cell, wears it away, and at last pushes forward, through a passage which is small at first, but which enlarges as the animal increases its efforts for emancipation ; while the tattered remnants of its aurelia skin lie in confusion within the cone, like a bundle of dirty linen.

The animal, when thus set free from its double confine-

ment, appears exhausted with fatigue, and seems produced for no other purpose but to transmit a future brood. It neither flies nor eats; the male only seeking the female, whose eggs he impregnates; and their union continues for four days, without interruption. The male dies immediately after separation from his mate; and she survives him only till she has laid her eggs, which are not hatched into worms till the ensuing spring.

However, there are few of these animals suffered to come to a state of maturity; for as their bursting through the cone destroys the silk, the manufacturers take care to kill the aurelia, by exposing it to the sun, before the moth comes to perfection. This done, they take of the floss, and throw the cones into warm water, stirring them till the first thread offers them a clue for winding all off. They generally take eight of the silken threads together; the cones still keep under water, till a proper quantity of the silk is wound off: however, they do not take all; for the latter parts grow weak, and are of a bad colour. As to the paper-like substance which remains, some stain it with a variety of colours, to make artificial flowers; others let it lie in the water, till the glutinous matter which cements it is all dissolved: it is then carded like wool, spun with a wheel, and converted into silk stuffs of an inferior kind.

 P A R T. IV.

C H A P. I.

Of the Fourth Order of Insects.

IN the foregoing part we treated of caterpillars changing into butterflies; in the present will be given the history of grubs changing into their corresponding winged animals. These, like the former, undergo their transformation, and appear as grubs or maggots, as aurelias, and at last as winged insects. Like the former, they are bred from eggs; they feed in their reptile state; they continue motionless and lifeless, as aurelias; and fly and propagate, when furnished with wings. But they differ in many respects: the grub or maggot wants the number of feet which the caterpillar is seen to have; the aurelia is not so totally wrapped up, but that its feet and its wings appear. The perfect animal, when emancipated, also has its wings either cased, or transparent, like gauze; not coloured with that beautifully painted dust which adorns the wings of the butterfly.

In this class of insects, therefore, we may place a various tribe that are first laid as eggs, then are excluded as maggots or grubs, then change into aurelias, with their legs and wings not wrapped up, but appearing; and lastly, assuming wings, in which state they propagate their kind. Some of these have four transparent wings, as bees; some have two membranous cases to their wings, as beetles; and some have but two wings, which are transparent, as ants. Here, therefore, we will place the bee, the wasp, the humble bee, the ichneumon fly, the gnat, the tipula or long legs, the beetle, the may-bug, the glow-worm, and the ant. The transformations which all these undergo, are pretty nearly similar; and though very different animals in form, are yet produced nearly in the same manner.

C H A P. II.

Of the Bee.

TO give a complete history of this insect in a few pages, which some have exhausted volumes in describing, and whose nature and properties still continue in dispute, is impossible. It will be sufficient to give a general idea of the animal's operations; which though they have been studied for more than two thousand years, are still but incompletely known. The account given us by Reaumur is sufficiently minute; and, if true, sufficiently wonderful: but I find many of the facts which he relates, doubted by those who are most conversant with bees; and some of them actually declared not to have a real existence in nature.

It is unhappy, therefore, for those whose method demands a history of bees, that they are unfurnished with those materials which have induced so many observers to contradict so great a naturalist. His life was spent in the contemplation; and it requires an equal share of attention to prove the error of his discoveries. Without entering, therefore, into the dispute, I will take him for my guide; and just mention, as I go along, those particulars in which succeeding observers have begun to think him erroneous. Which of the two are right, time only can discover; for my part I have only heard one side, for as yet none have been so bold as openly to oppose Reaumur's delightful researches.

There are three different kinds of bees in every hive. First, the labouring bees, which make up the far greatest number, and are thought to be neither male nor female, but merely born for the purposes of labour, and continuing the breed, by supplying the young with provision, while yet in their helpless state. The second sort are the drones; they are of a darker

colour, longer and more thick by one third than the former: they are supposed to be the males; and there is not above a hundred of them, in a hive of seven or eight thousand bees. The third sort is much larger than either of the former, and still fewer in number: some assert, that there is not above one in every swarm; but this, latter observers affirm not to be true, there being sometimes five or six in the same hive. These are called queen bees, and are said to lay all the eggs from which the whole swarm is hatched in a season.

In examining the structure of the common working bee, the first remarkable part that offers, is the trunk, which serves to extract the honey from flowers. It is not formed, like that of the other flies, in the manner of a tube, by which the fluid is to be sucked up; but like a besom, to sweep, or a tongue, to lick away. The animal is furnished also with teeth, which serve it in making wax. This substance is gathered from flowers, like honey; it consists of that dust or farina which contribute to the fecundation of plants, and is moulded into wax by the little animal, at leisure. Every bee, when it leaves the hive to collect this precious store, enters into the cup of the flower, particularly such as seem charged with the greatest quantities of this yellow farina. As the animal's body is covered over with hair, it rolls itself within the flower, and soon becomes quite covered with the dust, which it soon after brushes off with its two hind legs, and kneads into two little balls. In the thighs of the hind legs there are two cavities, edged with hair; and into these, as into a basket, the animal sticks its pellets. Thus employed, the bee flies from flower to flower, increasing its store, and adding to its stock of wax; until the ball, upon each thigh, becomes as big as a grain of pepper: by this time, having got a sufficient load, it returns, making the best of its way to the hive.

The belly of the bee is divided into six rings, which sometimes shorten the body, by slipping one over the other. It contains within it, beside the intestines, the honey-bag, the venom-bag, and the sting. The honey-bag is as transparent as crystal,

containing the honey that the bee has brushed from the flowers; of which the greater part is carried to the hive, and poured into the cells of the honey comb; while the remainder serves for the bee's own nourishment: for, during summer, it never touches what has been laid up for the winter. The sting which serves to defend this little animal from its enemies, is composed of three parts; the sheath, and two darts, which are extremely small and penetrating. Both the darts have several small points or barbs, like those of a fish-hook, which render the sting more painful, and make the darts rankle in the wound. Still, however, this instrument would be very slight, did not the bee poison the wound. The sheath, which has a sharp point, makes the first impression; which is followed by that of the darts, and then the venomous liquor is poured in. The sheath sometimes sticks so fast in the wound, that the animal is obliged to leave it behind; by which the bee soon after dies, and the wound is considerably inflamed. It might at first appear well for mankind, if the bee were without its sting: but, upon recollection, it will be found, that the little animal would then have too many rivals in sharing its labours. An hundred other lazy animals, fond of honey, and hating labour, would intrude upon the sweets of the hive; and the treasure would be carried off, for want of armed guardians to protect it.

From examining the bee singly, we now come to consider it in society, as an animal not only subject to laws, but active, vigilant, laborious, and disinterested. All its provisions are laid up for the community; and all its arts in building a cell, designed for the benefit of posterity. The substance with which bees build their cells is wax, which is fashioned into convenient apartments for themselves and their young. When they begin to work in their hives, they divide themselves into four companies: one of which roves in the fields in search of materials; another employs itself in laying out the bottom and partitions of their cells; a third is employed in making the inside smooth from the corners and angles; and the fourth company bring food for the rest, or relieve those who return with

their respective burdens. But they are not kept constant to one employment ; they often change the tasks assigned them : those that have been at work, being permitted to go abroad ; and those that have been in the fields already, take their places. They seem even to have signs, by which they understand each other ; for, when any of them wants food, it bends down its trunk to the bee from whom it is expected, which then opens its honey-bag, and lets some drops fall into the other's mouth, which is at that time opened to receive it. Their diligence and labour is so great, that, in a day's time, they are able to make cells, which lie upon each other, numerous enough to contain three thousand bees.

If we examine their cells, they will be found formed in the exactest proportion. It was said by Pappus, an ancient geometer, that, of all other figures, hexagons were the most convenient ; for, when placed touching each other, the most convenient room would be given, and the smallest lost. The cells of the bees are perfect hexagons : these, in every honeycomb, are double, opening on either side, and closed at the bottom. The bottoms are composed of little triangular panes, which, when united together, terminate in a point, and lie exactly upon the extremities of other panes of the same shape, in opposite cells. These lodgings have spaces, like streets, between them, large enough to give the bees a free passage in and out ; and yet narrow enough to preserve the necessary heat. The mouth of every cell is defended by a border, which makes the door a little less than the inside of the cell, which serves to strengthen the whole. These cells serve for different purposes : for laying up their young ; for their wax, which in winter becomes a part of their food ; and for their honey, which makes their principal subsistence.

It is well known that the habitation of bees ought to be very close ; and what their hives want, from the negligence or unskilfulness of man, these animals supply by their own industry : so that it is their principal care, when first hived, to stop up all the crannies. For this purpose, they make use of a

resinous gum, which is more tenacious than wax, and differs greatly from it. This the ancients called propolis: it will grow considerably hard in June; though it will in some measure soften by the heat; and is often found different in consistence, colour and smell. It has generally an agreeable aromatic odour when it is warmed; and by some it is considered as a most grateful perfume. When the bees begin to work with it, it is soft, but it acquires a firmer consistence every day; till at length it assumes a brown colour, and becomes much harder than wax. The bees carry it on their hinder legs; and some think it is met with on the birch, the willow, and poplar. However it is procured, it is certain that they plaster the inside of their hives with this composition.

If examined through a glass hive, from the hurry the whole swarm is in, the whole at first appears like anarchy and confusion: but the spectator soon finds every animal diligently employed and following one pursuit, with a settled purpose. Their teeth are the instruments by which they model and fashion their various buildings, and give them such symmetry and perfection. They begin at the top of the hive; and several of them work at a time, at the cells which have two faces. If they are stinted with regard to time, they give the new cells but half the depth which they ought to have; leaving them imperfect, till they have sketched out the number of cells necessary for the present occasion. The construction of their combs, costs them a great deal of labour: they are made by insensible additions; and not cast at once in a mould, as some are apt to imagine. There seems no end of their shaping, finishing, and turning them neatly up. The cells for their young are most carefully formed; those designed for lodging the drones, are larger than the rest; and that for the queen-bee, the largest of all. The cells in which the young brood are lodged, serve at different times for containing honey; and this proceeds from an obvious cause: every worm, before it is transformed into an aurelia, hangs its old skin on the partitions of its cell; and thus, while it strengthens the wall, diminishes the capacity of its late apartment. The same cell,

in a single summer, is often tenanted by three or four worms in succession; and the next season, by three or four more. Each worm takes particular care to fortify the pannels of its cell, by hanging up its spoils there: thus, the partitions being lined, six or eight deep, become at last too narrow for a new brood, and are converted into store-houses, for honey.

Those cells where nothing but honey is deposited, are much deeper than the rest. When the harvest of honey is so plentiful that they have not sufficient room for it, they either lengthen their combs, or build more; which are much longer than the former. Sometimes they work at three combs at a time; for, when there are three work-houses, more bees may be thus employed, without embarrassing each other.

But honey, as was before observed, is not the only food upon which these animals subsist. The meal of flowers, of which their wax is formed, is one of their most favourite repasts. This is a diet which they live upon during the summer; and of which they lay up a large winter provision. The wax of which their combs are made, is no more than this meal digested, and wrought into a paste. When the flower upon which bees generally feed, are not fully blown, and this meal or dust is not offered in sufficient quantities, the bees pinch the tops of the stamina in which it is contained, with their teeth; and thus anticipate the progress of vegetation. In April and May, the bees are busy, from morning to evening, in gathering this meal; but when the weather becomes too hot in the midst of summer, they work only in the morning.

The bee is furnished with a stomach for its wax, as well as its honey. In the former of the two, their powder is altered, digested and concocted into real wax; and is thus ejected by the same passage by which it was swallowed. Every comb, newly made, is white: but it becomes yellow as it grows old, and almost black when kept too long in the hive. Beside the wax thus digested, there is a large portion of the powder kneaded up for food in every hive, and kept in separate cells, for winter provision. This is called, by the country people, bee-

bread ; and contributes to the health and strength of the animal during winter. Those who rear bees, may rob them of their honey, and feed them, during the winter, with treacle ; but no proper substitute has yet been found for the bee-bread ; and, without it, the animals become consumptive and die.

As for the honey, it is extracted from that part of the flower called the nectareum. From the mouth this delicious fluid passes into the gullet: and then into the first stomach, or honey-bag, which, when filled, appears like an oblong bladder. Children, that live in country places, are well acquainted with this bladder ; and destroy many bees to come at their store of honey. When a bee has sufficiently filled its first stomach, it returns back to the hive, where it disgorges the honey into one of the cells. It often happens that the bee delivers its store to some other, at the mouth of the hive, and flies off for a fresh supply. Some honey-combs are always left open for common use ; but many others are stopped up, till there is a necessity of opening them. Each of these are covered carefully with wax ; so close, that the covers seem to be made at the very instant the fluid is deposited within them.

Having thus given a cursory description of the insect, individually considered, and of the habitation it forms, we next come to its social habits and institutions: and, in considering this little animal attentively, after the necessary precautions for the immediate preservation of the community, its second care is turned to the continuance of posterity. How numerous soever the multitude of bees may appear in one swarm, yet they all owe their original to a single parent, which is called the queen-bee. It is indeed surprizing that a single insect shall, in one summer, give birth to above twenty thousand young: but, upon opening her body, the wonder will cease ; as the number of eggs appearing, at one time, amounts to five thousand. This animal, whose existence is of such importance to her subjects, may easily be distinguished from the rest, by her size, and the shape of her body. On her safety depends the whole welfare of the commonwealth ; and the attentions

paid her by all the rest of the swarm, evidently show the dependence her subjects have upon her security. If this insect be carefully observed, she will be seen at times attended with a numerous retinue, marching from cell to cell, plunging the extremity of her body into many of them, and leaving a small egg in each.

The bees which generally compose her train, are thought to be males, which serve to impregnate her by turns. These are larger and blacker than the common bees; without stings, and without industry. They seem formed only to transmit a posterity; and to attend the queen, whenever she thinks proper to issue from the secret retreats of the hive, where she most usually resides. Upon the union of these two kinds depends all expectations of a future progeny; for the working bees are of no sex, and only labour for another offspring: yet such is their attention to their queen, that if she happens to die, they will leave off working, and take no farther care of posterity. If, however, another queen is in this state of universal despair presented them, they immediately acknowledge her for sovereign, and once more diligently apply to their labour. It must be observed, however, that all this fertility of the queen-bee, and the great attentions paid to her by the rest, are controverted by more recent observers. They assert, that the common bees are parents themselves; that they deposit their eggs in the cells which they have prepared; that the females are impregnated by the males, and bring forth a progeny, which is wholly their own.

However, to go on with their history, as delivered us by mr. Reaumur—When the queen-bee has deposited the number of eggs necessary in the cells, the working bees undertake the care of the rising posterity. They are seen to leave off their usual employments; to construct proper receptacles for eggs; or to complete those that are already formed. They purposely build little cells, extremely solid, for the young; in which they employ a great deal of wax: those designed for lodging the males, as was already observed, are larger than

the rest ; and those for the queen-bees the largest of all. There is usually but one egg deposited in every cell ; but when the fecundity of the queen is such, that it exceeds the number of cells already prepared, there are sometimes three or four eggs crowded together in the same apartment. But this is an inconvenience that the working bees will by no means suffer. They seem sensible, that two young ones, stuffed up in the same cell, when they grow larger, will but embarrass, and at last destroy each other : they therefore take care to leave a cell to every egg ; and remove or destroy the rest.

The single egg that is left remaining, is fixed to the bottom of the cell, and touches it but in a single point. A day or two after it is deposited, the worm is excluded from the shell of the egg, having the appearance of a maggot rolled up in a ring, and lying softly on a bed of a whitish coloured jelly ; upon which also the little animal begins to feed. In the mean time, the instant it appears, the working bees attend it with the most anxious and parental tenderness ; they furnish it every hour with a supply of this whitish substance, on which it feeds and lies ; and watch the cell with unremitting care. They are nurses that have a greater affection for the offspring of others, than many parents have for their own children. They are constant in visiting each cell, and seeing that nothing is wanting ; preparing the white mixture, which is nothing but a composition of honey and wax, in their own bowels, with which they feed them. Thus attended, and plentifully fed, the worm, in less than six days time, comes to its full growth, and no longer accepts the food offered it. When the bees perceive that it has no further occasion for feeding, they perform the last offices of tenderness, and shut the little animal up in its cell ; walling up the mouth of its apartment with wax : there they leave the worm to itself ; having secured it from every external injury.

The worm is no sooner left enclosed, but, from a state of inaction, it begins to labour, extending and shortening its body ; and by this means, lining the walls of its apartment

with a filken tapestry, which it spins in the manner of caterpillars, before they undergo their last transformation. When their cell is thus prepared, the animal is soon after transformed into an aurelia; but differing from that of the common caterpillar, as it exhibits not only the legs, but the wings of the future bee, in its present state of activity. Thus, in about twenty, or one and twenty days after the egg was laid, the bee is completely formed, and fitted to undergo the fatigues of its state. When all its parts have acquired their proper strength and consistence, the young animal opens its prison, by piercing with its teeth the waxen door that confines it. When just freed from its cell, it is as yet moist, and incommoded with the spoils of its former situation; but the officious bees are soon seen to flock round it, and to lick it clean on all sides with their trunks; while another band, with equal assiduity, are observed to feed it with honey: others again begin immediately to cleanse the cell that has been just left; to carry the ordures out of the hive, and to fit the place for a new inhabitant. The young bee soon repays their care, by its industry; for as soon as ever its external parts become dry, it discovers its natural appetites for labour, and industriously begins the task, which it pursues unremittingly through life. The toil of man is irksome to him, and he earns his subsistence with pain; but this little animal seems happy in its pursuits, and finds delight in all its employments.

When just freed from the cell, and properly equipped by its fellow bees for duty, it at once issues from the hive, and instructed only by nature, goes in quest of flowers, chooses only those that yield it a supply, rejects such as are barren of honey, or have been already drained by other adventurers; and when loaded, is never at a loss to find its way back to the common habitation. After this first sally, it begins to gather the mealy powder, that lies on every flower, which is afterwards converted into wax; and with this, the very first day it returns with two large balls stuck to its thighs.

When bees first begin to break their prisons, there are generally above a hundred excluded in one day. Thus, in the

space of a few weeks, the number of the inhabitants in one hive, of moderate size, becomes so great, that there is no place to contain the new-comers : and they are scarcely excluded from the cell, when they are obliged, by the old bees, to fall forth in quest of new habitations. In other words, the hive begins to swarm, and the new progeny prepares for exile.

While there is room enough in the hive, the bees remain quietly together ; it is necessity alone that compels the separation. Sometimes, indeed, the young brood, with graceless obstinacy, refuse to depart, and even venture to resist their progenitors. The young ones are known by being browner than the old, with whiter hair ; the old ones are of a lighter colour, with red hair. The two armies are therefore easily distinguishable, and dreadful battles are often seen to ensue. But the victory almost ever terminates, with strict poetical justice, in favour of the veterans, and the rebellious offspring are driven off, not without loss and mutilation.

In different countries, the swarms make their appearance at different times of the year, and there are several signs previous to this intended migration. The night before, an unusual buzzing is heard in the hive ; in the morning, though the weather be soft and inviting, they seem not to obey the call, being intent on more important meditations within. All labour is discontinued in the hive, every bee is either employed in forcing, or reluctantly yielding a submission ; at length, after some noise and tumult, a queen-bee is chosen, to guard, rather than conduct, the young colony to other habitations, and then they are marshalled without any apparent conductor. In less than a minute, they leave their native abode, and forming a cloud round their protectress, they set off, without seeming to know the place of their destination ; *The world before them, where to choose their place of rest.* The usual time of swarming, is from ten in the morning, to three in the afternoon, when the sun shines bright, and invites them to seek their fortunes. They flutter for a while, in the air, like flakes of snow,

and sometimes undertake a distant journey, but more frequently are contented with some neighbouring asylum; the branch of a tree, a chimney top, or some other exposed situation. It is, indeed, remarkable, that all those animals, of whatever kind, that have long been under the protection of man, seem to lose a part of their natural sagacity, in providing for themselves. The rabbit, when domesticated, forgets to dig holes, the hen to build a nest, and the bee to seek a shelter, that shall protect it from the inclemencies of winter. In those countries, where the bees are wild, and unprotected by man, they are always sure to build their waxen cells in the hollow of a tree; but with us, they seem improvident in their choice, and the first green branch that stops their flight, seems to be thought sufficient for their abode through winter. However, it does not appear, that the queen chooses the place where they are to alight, for many of the stragglers, who seem to be pleased with a particular branch, go and settle upon it; others are seen to succeed, and at last, the queen herself, when she finds a sufficient number there before her, goes to make it the place of her head-quarters. When the queen is settled, the rest of the swarm soon follow; and, in about a quarter of an hour, the whole body seem at ease. It sometimes is found, that there are two or three queens to a swarm, and the colony is divided into parties; but it most usually happens, that one of these is more considerable than the other, and the bees by degrees, desert the weakest, to take shelter under the most powerful protector. The deserted queen does not long survive this defeat; she takes refuge under the new monarch, and is soon destroyed by her jealous rival. Till this cruel execution is performed, the bees never go out to work; and if there should be a queen bee, belonging to the new colony, left in the old hive, she always undergoes the fate of the former. However, it must be observed, that the bees never sacrifice any of their queens, when the hive is full of wax and honey; for there is at that time, no danger in maintaining a plurality of breeders.

When the swarm is thus conducted to a place of rest, and the policy of government is settled, the bees soon resume their

former labours. The making cells, storing them with honey, impregnating the queen, making proper cells for the reception of the rising progeny, and protecting them from external danger, employ their unceasing industry. But soon after, and towards the latter end of summer, when the colony is sufficiently stored with inhabitants, a most cruel policy ensues. The drone bees, which are (as has been said) generally in a hive, to the number of a hundred, are marked for slaughter. These, which had hitherto led a life of indolence and pleasure, whose only employment was in impregnating the queen, and rioting upon the labours of the hive, without aiding in the general toil, now share the fate of most voluptuaries, and fall a sacrifice to the general resentment of society.

The working bees, in a body, declare war against them; and in two or three days time, the ground all round the hive is covered with their dead bodies. Nay, the working bees will even kill such drones, as are yet in the worm state, in the cell, and eject their bodies from the hive among the general carnage.

When a hive sends out several swarms in the year, the first is always the best, and the most numerous. These, having the whole summer before them, have more time for making wax and honey, and consequently their labours are the most valuable to the proprietor. Although the swarm chiefly consists of the youngest bees, yet it is often found, that bees of all ages compose the multitude of emigrants, and it often happens, that bees of all ages are seen remaining behind. The number of them is always more considerable than that of some populous cities, for sometimes upwards of forty thousand are found in a single hive. So large a body may well be supposed to work with great expedition; and in fact, in less than twenty-four hours, they will make combs above twenty inches long, and seven or eight broad. Sometimes they will half fill their hives with wax, in less than five days. In the first fifteen days, they are always found to make more wax than they do afterwards during the rest of the year.

Such are the out-lines of the natural history of these ani-

mals, as usually found in our own country. How they are treated, so as to produce the greatest quantity of honey, belongs rather to the rural economist, than the natural historian; volumes have been written on the subject, and still more remains equally curious and new. One thing, however, it may be proper to observe, that a farm, or a country, may be over-stocked with bees, as with any other sort of animal; for a certain number of hives, always require a certain number of flowers to subsist on. When the flowers near home are rifled, then are these industrious insects seen taking more extensive ranges, but their abilities may be over-taxed; and if they are obliged, in quest of honey, to go too far from home, they are over-wearied in the pursuit, they are devoured by birds, or beat down by the winds and rain.

From a knowledge of this, in some parts of France and Piedmont, they have contrived, as I have often seen, a kind of floating bee-house.

They have on board one barge, three score or a hundred bee-hives, well defended from the inclemency of an accidental storm; and with these, the owners suffer themselves to float gently down the river. As the bees are continually choosing their flowery pasture along the banks of the stream, they are furnished with sweets before unrifled: and thus a single floating bee-house, yields the proprietor a considerable income. Why a method similar to this has never been adopted in England, where we have more gentle rivers, and more flowery banks, than in any other part of the world, I know not; certainly it might be turned to advantage, and yield the possessor a secure, though perhaps a moderate income.

Having mentioned the industry of these admirable insects, it will be proper to say something of the effects of their labour, of that wax and honey, which are turned by man to such various uses. Bees produce two kinds of wax, one coarse and the other fine. The coarser sort is bitter, and with this, which is called *propolis*, they stop up the holes and crevices of their hives. It is of a more resinous nature than the fine wax,

and is consequently better qualified to resist the moisture of the season, and preserve the works warm and dry within. The fine wax is as necessary to the animals' preservation as the honey itself. With this they make their lodgings, with this they cover the cells of their young, and in this they lay up their magazines of honey. This is made, as has been already observed, from the dust of flowers, which is carefully kneaded by the little insect, then swallowed, and having undergone a kind of digestion, is formed into the cells, which answers such a variety of purposes. To collect this, the animal rolls itself in the flower it would rob, and thus takes up the vegetable dust with the hair of its body. Then carefully brushing it into a lump, with its fore paws it thrusts the composition into two cavities behind the thighs, which are made like spoons to receive the wax, and the hair that lines them, serves to keep it from falling.

As of wax, there are also two kinds of honey. The white and the yellow. The white is taken without fire from the honey-combs. The yellow is extracted by heat, and squeezed through bags, in a press. The best honey is new, thick, and granulated, of a clear transparent white colour, of a soft and aromatic smell, and of a sweet lively taste. Honey made in mountainous countries, is preferable to that of the valley. The honey made in the spring, is more highly esteemed, than that gathered in the summer, which last is still more valuable, than that of autumn, when the flowers begin to fade and lose their fragrance.

The bees are nearly alike in all parts of the world, yet there are differences worthy our notice. In Guadaloupe, the bee is less by one half, than the European, and more black and round. They have no sting, and make their cells in hollow trees; where, if the hole they meet with is too large, they form a sort of waxen house, of the shape of a pear, and in this they lodge and store their honey, and lay their eggs. They lay up their honey in waxen vessels, of the size of a pigeon's egg, of a black or deep violet colour; and these are so joined together, that

there is no space left between them. The honey never congeals, but is fluid, of the consistence of oil, and the colour of amber. Resembling these, there are found little black bees, without a sting, in all the tropical climates; and though these countries are replete with bees, like our own, yet those form the most useful and laborious tribe in that part of the world. The honey they produce, is neither so unpalatable, nor so surfeiting as ours; and the wax is so soft, that it is only used for medicinal purposes, it being never found hard enough to form into candles, as in Europe.

Of insects, that receive the name of bees, among us, there are several; which, however, differ very widely from that industrious social race we have been just describing. The *humble bee* is the largest of all this tribe, being as large as the first joint of one's middle finger. These are seen in every field, and perched on every flower. They build their nests in holes in the ground, of dry leaves mixed with wax and wool, defended with moss from the weather. Each humble bee makes a separate cell about the size of a small nutmeg, which is round and hollow, containing the honey in a bag. Several of these cells are joined together, in such a manner, that the whole appears like a cluster of grapes. The females, which have the appearance of wasps, are very few, and their eggs are laid in cells, which the rest soon cover over with wax. It is uncertain whether they have a queen or not; but there is one much larger than the rest, without wings, and without hair, and all over black, like polished ebony. This goes and views all the works, from time to time, and enters into the cell, as if it wanted to see whether every thing was done right: in the morning, the young humble bees are very idle, and seem not at all inclined to labour, till one of the largest, about seven o'clock, thrusts half its body from a hole, designed for that purpose, and seated on the top of the nest, beats its wing for twenty minutes successively, buzzing the whole time, till the whole colony is put in motion. The humble bees gather honey, as well as the common bees; but it is neither so fine, nor so good, nor the wax so clean, or so capable of fusion.

Besides the bees already mentioned, there are various kinds among us, that have much the appearance of honey-makers, and yet make only wax. The *wood bee* is seen in every garden. It is rather larger than the common queen bee; its body of a bluish black, which is smooth and shining. It begins to appear at the approach of spring, and is seen flying near walls exposed to a sunny aspect. This bee makes its nest in some piece of wood, which it contrives to scoop and hollow for its purpose. This, however, is never done in trees that are standing, for the wood it makes choice of is half rotten. The holes are not made directly forward, but turning to one side, and have an opening sufficient to admit one's middle finger; from whence runs the inner apartment, generally twelve or fifteen inches long. The instruments used in boring these cavities, are their teeth; the cavity is usually branched into three or four apartments; and in each of these, they lay their eggs, to the number of ten or twelve, each separate and distinct from the rest: The eggs are involved in a sort of paste, which serves at once for the young animal's protection and nourishment. The grown bees, however, feed upon small insects, particularly a louse, of a reddish brown colour, of the size of a small pin's head.

Mason bees make their cells with a sort of mortar, made of earth, which they build against a wall that is exposed to the sun. The mortar, which at first is soft, soon becomes as hard as stone, and in this their eggs are laid. Each nest contains seven or eight cells, an egg in every cell, placed regularly one over the other. If the nest remains unhurt, or wants but little repairs, they make use of them the year ensuing: and thus they often serve three or four years successively. From the strength of their houses, one would think these bees in perfect security, yet none are more exposed than they. A worm with very strong teeth, is often found to bore into their little fortifications, and devour their young.

The *ground bee* builds its nest in the earth, wherein they make round holes, five or six inches deep; the mouth being

narrow, and only just sufficient to admit the little inhabitant. It is amusing enough, to observe the patience and assiduity with which they labour. They carry out all the earth, grain by grain, to the mouth of the hole, where it forms a little hillock, an alps compared to the power of the artist by which it is raised. Sometimes the walks of a garden are found undermined by their labours; some of the holes running directly downward, others horizontally beneath the surface. They lay up in these cavities provisions for their young, which consist of a paste that has the appearance of corn, and is of a sweetish taste.

The *leaf-cutting bees* make their nest and lay their eggs among bits of leaves, very artificially placed in holes in the earth, of about the length of a tooth-pick case. They make the bits of leaves of a roundish form, and with them line the inside of their habitations. This tapestry is still further lined by a reddish kind of paste, somewhat sweet or acid. These bees are of various kinds; those that build their nests with chesnut-leaves are as big as drones, but those of the rose-tree are smaller than the common bee.

The *wall bees* are so called, because they make their nests in walls of a kind of silky membrane with which they fill up the vacuities between the small stones which form the sides of their habitation. Their apartment consists of several cells placed end to end, each in the shape of a woman's thimble. Though the web which lines this habitation is thick and warm, yet it is transparent and of a whitish colour. This substance is supposed to be spun from the animal's body; the male and females are of a size, but the former are without a sting. To these varieties of the bee kind might be added several others, which are all different in nature, but not sufficiently distinguished to excite curiosity.

C H A P. III.

Of the Wasp.

HOWEVER similar many insects may be in appearance, this does not imply a similitude in their history. The bee and the wasp resemble each other very strongly, yet, in examining their manner and their duration, they differ very widely; the bee labours to lay up honey, and lives to enjoy the fruits of its industry; the wasp appears equally assiduous, but only works for posterity, as the habitation is scarcely completed when the inhabitant dies.

The wasp is well known to be a winged insect with a sting. To be longer in proportion to its bulk than the bee, to be marked with bright yellow circles round its body, and to be the most swift and active insect of all the fly kind. On each side of the mouth this animal is furnished with a long tooth, notched like a saw, and with these it is enabled to cut any substance, not omitting meat itself, and to carry it to its nest. Wasps live like bees in community, and sometimes ten or twelve thousand are found inhabiting a single nest.

Of all other insects the wasp is the most fierce, voracious, and most dangerous, when enraged. They are seen wherever flesh is cutting up, gorging themselves with the spoil, and then flying to their nests with their reeking prey. They make war also on every other fly, and the spider himself dreads their approaches.

Every community among bees is composed of females or queens, drones or males, and neutral or working bees. Wasps have similar occupations; the two first are for propagating the species, the last for nursing, defending, and supporting the rising progeny. Among bees, however, there is seldom above

a queen or two in a hive ; among wasps there are above two or three hundred.

As soon as the summer begins to invigorate the insect tribes, the wasps are the most of the number, and diligently employed either in providing provisions for their nest, if already made, or in making one, if the former habitation be too small to receive the increasing community. The nest is one of the most curious objects in natural history, and contrived almost as artificially as that of the bees themselves. Their principal care is to seek out a hole that has been begun by some other animal, a field mouse, a rat, or a mole, to build their nests in. They sometimes build upon the plain, where they are sure of the driness of their situation, but most commonly on the side of a bank, to avoid the rain or water that would otherwise annoy them. When they have chosen a proper place, they go to work with wonderful assiduity. Their first labour is to enlarge and widen the hole, taking away the earth and carrying it off to some distance. They are perfectly formed for labour, being furnished with a trunk above their mouths, two saws on each side, which play to the right and left against each other, and six strong muscular legs to support them. They cut the earth into small parcels with their saws, and carry it out with their legs or paws. This is the work of some days ; and at length the outline of their habitation is formed, making a cavity of about a foot and a half every way. While some are working in this manner, others are roving the fields to seek out materials for their building. To prevent the earth from falling down and crushing their rising city into ruin, they make a sort of roof with their gluey substance, to which they begin to fix the rudiments of their building, working from the top downwards, as if they were hanging a bell, which, however, at length they close up at the bottom. The materials with which they build their nests are bits of wood and glue. The wood they get where they can, from the rails and posts which they meet with in the fields and elsewhere. These they saw and divide into a multitude of small fibres, of which they take up little bundles in their claws, letting fall upon them a few drops of gluey matter with which

their bodies are provided, by the help of which they knead the whole composition into a paste, which serves them in their future building. When they have returned with this to their nest, they stick their load of paste on that part where they make their walls and partitions; they tread it close with their feet, and trowel it with their trunks, still going backwards as they work. Having repeated this operation three or four times, the composition is at length flatted out until it becomes a small leaf of a grey colour, much finer than paper, and of a pretty firm texture. This done, the same wasp returns to the field to collect a second load of paste, repeating the same several times, placing layer upon layer, and strengthening every partition in proportion to the wants or convenience of the general fabric. Other working wasps come quickly after to repeat the same operation, laying more leaves upon the former, till at length, after much toil, they have finished the large roof which is to secure them from the tumbling in of the earth. This dome being finished, they make another entrance to their habitation, designed either for letting in the warmth of the sun, or for escaping in case one door be invaded by plunderers. Certain, however, it is, that by one of these they always enter, by the other they sally forth to their toil; each hole being so small that they can pass but one at a time. The walls being thus composed, and the whole somewhat of the shape of a pear, they labour at their cells, which they compose of the same paper-like substance that goes to the formation of their outside works. Their combs differ from those of bees, not less in the composition than the position which they are always seen to obtain. The honey-comb of the bee is edgeways with respect to the hive; that of the wasp is flat, and the mouth of every cell opens downwards. Thus is their habitation, contrived story above story, supported by several rows of pillars which give firmness to the whole building, while the upper story is flat-roofed, and as smooth as the pavement of a room, laid with squares of marble. The wasps can freely walk upon these stories between the pillars, to do whatever their wants require. The pillars are very hard and compact, being larger at each

end than in the middle, not much unlike the columns of a building. All the cells of the nest are only destined for the reception of the young, being replete with neither wax nor honey.

Each cell is like that of the bee, hexagonal ; but they are of two sorts, the one larger for the production of the male and female wasps, the other less for the reception of the working part of the community. When the females are impregnated by the males, they lay their eggs, one in each cell, and stick it in with a kind of gummy matter to prevent its falling out. From this egg proceeds the insect in its worm-state, of which the old ones are extremely careful, feeding it from time to time till it becomes large and entirely fills up its cell. But the wasp community differs from that of the bee in this ; that among the latter the working bees take the parental duties upon them, whereas among the wasps the females alone are permitted to feed their young, and to nurse their rising progeny. For this purpose, the female waits with great patience till the working wasps have brought in their provisions, which she takes from them, and cuts into pieces. She then goes with great composure from cell to cell, and feeds every young one with her mouth. When the young worms have come to a certain size, they leave off eating, and begin to spin a very fine silk, fixing the first end to the entrance of the cell, then turning their heads, first on one side, then on the other, they fix the thread to different parts, and thus they make a sort of a door which serves to close up the mouth of the cell. After this they divest themselves of their skins after the usual mode of transformation, the aurelia by degrees begins to emancipate itself from its shell ; by little and little it thrusts out its legs and wings, and insensibly acquires the colour and shape of its parent.

The wasp thus formed, and prepared for depredation, becomes a bold, troublesome, and dangerous insect : there are no dangers which it will not encounter in pursuit of its prey, and nothing seems to satiate its gluttony. Though it can gather no honey of its own, no animal is more fond of sweets.

For this purpose, it will pursue the bee and the humble bee, destroy them with its sting, and then plunder them of their honey-bag, with which it flies triumphantly loaded to its nest to regale its young. Wasps are ever fond of making their nests in the neighbourhood of bees, merely to have an opportunity of robbing their hives, and feasting on the spoil. Yet the bees are not found always patiently submissive to their tyranny, but fierce battles are sometimes seen to ensue, in which the bees make up by conduct and numbers what they want in personal prowess. When there is no honey to be had, they seek for the best and sweetest fruits, and they are never mistaken in their choice. From the garden they fly to the city, to the grocers' shops, and butchers' shambles. They will sometimes carry off bits of flesh half as big as themselves, with which they fly to their nests for the nourishment of their brood. Those who cannot drive them away, lay for them a piece of ox's liver, which being without fibres, they prefer to other flesh; and whenever they are found, all other flies are seen to desert the place immediately. Such is the dread with which these little animals impress all the rest of the insect tribes, which they seize and devour without mercy, that they vanish at their approach. Wherever they fly, like the eagle or the falcon, they form a desert in the air around them. In this manner the summer is passed in plundering the neighbourhood, and rearing up their young; every day adds to their numbers, and from their strength, agility, and indiscriminate appetite for every kind of provision, were they as long lived as the bee, they would soon swarm upon the face of nature, and become the most noxious plague of man: but providentially their lives are measured to their mischief, and they live but a single season.

While the summer heats continue, they are bold, voracious, and enterprising; but as the sun withdraws, it seems to rob them of their courage and activity. In proportion as the cold increases, they are seen to become more domestic; they seldom leave the nest; they make but short adventures from home; they flutter about in the noon-day heats, and soon after return chilled and feeble.

As their calamities increase, new passions soon begin to take place ; the care for posterity no longer continues, and as the parents are no longer able to provide their growing progeny a supply, they take the barbarous resolution of sacrificing them all to the necessity of the times. In this manner, like a garrison upon short allowance, all the useless hands are destroyed ; the young worms, which a little before they fed and protected with so much assiduity, are now butchered and dragged from their cells. As the cold increases, they no longer find sufficient warmth in their nests, which grow hateful to them, and they fly to seek it in the corners of houses, and places that receive an artificial heat. But the winter is still insupportable ; and, before the new year begins, they wither and die ; the working wasps first, the males soon following, and many of the females suffering in the general calamity. In every nest, however, one or two females survive the winter, and having been impregnated by the male during the preceding season, she begins in spring to lay her eggs in a little hole of her own contrivance. This bundle of eggs, which is clustered together like grapes, soon produces two worms, which the female takes proper precaution to defend and supply, and these when hatched, soon give assistance to the female, who is employed in hatching two more ; these also gathering strength, extricate themselves out of the web that enclosed them, and become likewise assistance to their mother ; fifteen days after, two more make their appearance ; thus is the community every day increasing, while the female lays in every cell, first a male and then a female. These soon after become breeders in turn, till, from a single female, ten thousand wasps are seen produced before the month of June. After the female has thus produced her progeny, which are distributed in different districts, they assemble from all parts, in the middle of summer, and provide for themselves the large and commodious habitation, which has been described above.

Such is the history of the social wasp ; but, as among bees, so also among these insects, there are various tribes that live in solitude : these lay their eggs in a hole for the purpose, and

the parent dies long before the birth of its offspring. In the principal species of the *solitary wasps*, the insect is smaller than the working wasp of the social kind. The filament, by which the corselet is joined to the body, is longer and more distinctly seen, and the whole colour of the insect is blacker than in the ordinary kinds. But it is not their figure, but the manners of this extraordinary insect that claim our principal regard.

From the end of May to the beginning of July, this wasp is seen most diligently employed. The whole purpose of its life seems to be in contriving and fitting up a commodious apartment for its young one, which is not to succeed it till the year ensuing. For this end, it is employed, with unwearied assiduity, in boring a hole into the finest earth some inches deep, but not much wider than the diameter of its own body. This is but a gallery leading to a wider apartment, destined for the convenient lodgment of its young. As it always chooses a gravelly soil to work in, and where the earth is almost as hard as stone itself; the digging and hollowing this apartment is an enterprize of no small labour: for effecting its operations, this insect is furnished with two teeth, which are strong and firm, but not sufficiently hard to penetrate the substance through which it is resolved to make its way. In order therefore to soften that earth which it is unable to pierce, it is furnished with a gummy liquer which it emits upon the place, and which renders it more easily separable from the rest, and the whole becoming a kind of soft paste, is removed to the mouth of the habitation. The animal's provision of liquor in these operations is, however, soon exhausted; and it is then seen either taking up water from some neighbouring flower or stream, in order to supply the deficiency.

At length, after much toil, a hole some inches deep is formed, at the bottom of which is a large cavity; and to this no other hostile insect would venture to find its way, from the length and the narrowness of the defile through which it would be obliged to pass. In this the solitary wasp lays its egg, which is destined to continue the species; there the nascent animal

is to continue for above nine months, unattended and immured, and at first appearance the most helpless insect of the creation. But when we come to examine, new wonders offer; no other insect can boast so copiously luxurious a provision, or such confirmed security.

As soon as the mother-wasp has deposited her egg at the bottom of the hole, her next care is to furnish it with a supply of provisions, which may be offered to the young insect as soon as it leaves the egg. To this end, she procures a number of little green worms, generally from eight to twelve, and these are to serve as food for the young one the instant it awakens into life. When this supply is regularly arranged and laid in, the old one then, with as much assiduity as it before worked out its hole, now closes the mouth of the passage; and thus leaving its young one immured in perfect security, and, in a copious supply of animal food, she dies satisfied with having provided for a future progeny.

When the young one leaves the egg, it is scarcely visible, and is seen immured among a number of insects, infinitely larger than itself, ranged in proper order around it, which, however, give it no manner of apprehension. Whether the parent, when she laid in the insect provision, contrived to disable the worms from resistance, or whether they were at first incapable of any, is not known. Certain it is, that the young glutton feasts upon the living spoil without any controul; his game lies at his hand, and he devours one after the other as the calls of appetite incite him. The life of the young animal is therefore spent in the most luxurious manner, till its whole stock of worms is exhausted, and then the time of its transformation begins to approach; and then spinning a silken web, it continues fixed in its cell till the sun calls it from its dark abode the ensuing summer.

The wasps of Europe are very mischievous, yet they are innocence itself when compared to those of the tropical climates, where all the insect tribes are not only numerous, but large, voracious, and formidable. Those of the West-Indies

are thicker, and twice as long as the common bee; they are of a grey colour, striped with yellow, and armed with a very dangerous sting. They make their cells in the manner of a honey-comb, in which the young ones are hatched and bred: They generally hang their nests by threads, composed of the same substance with the cells, to the branches of trees, and the eaves of houses. They are seen every where in great abundance, descending like fruit, particularly pears, of which shape they are, and as large as one's head. The inside is divided into three round stories, full of cells, each hexagonal, like those of a honey-comb. In some of the islands, these insects are so very numerous, that their nests are stuck up in this manner, scarce two feet asunder, and the inhabitants are in continual apprehension from their accidental resentment. It sometimes happens, that no precautions can prevent their attacks, and the pains of their sting is almost insupportable. Those who have felt it, think it more terrible than even that of a scorpion; the whole visage swells, and the features are so disfigured, that a person is scarcely known by his most intimate acquaintance.

C H A P. IV.

Of the Ichneumon Fly.

EVERY rank of insects, how voracious soever, have enemies that are terrible to them, and that revenge upon them the injuries done upon the rest of the animated creation. The wasp, as we have seen, is very troublesome to man, and very formidable to the insect tribe; but the ichneumon fly (of which there are many varieties) fears not the wasp itself; it enters its retreats, plunders its inhabitants, and takes possession of that cell for its own young, which the wasp had laboriously built for a dearer posterity.

Though there are many different kinds of this insect, yet the most formidable, and that best known, is called the common ichneumon, with four wings, like the bee, a long slender black body, and a three-forked tail, consisting of bristles; the two outermost black, and the middlemost red. This fly receives its name from the little quadruped, which is found to be so destructive to the crocodile, as it bears a strong similitude in its courage and rapacity.

Though this instrument is, to all appearance, slender and feeble, yet is it found to be a weapon of great force and efficacy. There is scarce any substance which it will not pierce; and, indeed, it is seldom seen but employed in penetration. This is the weapon of defence, this is employed in destroying its prey, and still more, by this the animal deposits her eggs wherever she thinks fit to lay them. As it is an instrument chiefly employed for this purpose, the male is unprovided with such a sting, while the female uses it with great force and dexterity, brandishing it when caught, from side to side, and very often wounding those who thought they held her with the greatest security.

All the flies of this tribe are produced in the same manner, and owe their birth to the destruction of some other insect, within whose body they have been deposited, and upon whose vitals they have preyed, till they came to maturity. There is no insect whatever, which they will not attack, in order to leave their fatal present in its body; the caterpillar, the gnat, and even the spider himself, so formidable to others, is often made the unwilling fosterer of this destructive progeny.

About the middle of summer, when other insects are found in great abundance, the ichneumon is seen flying busily about, and seeking proper objects upon whom to depose its progeny. As there are various kinds of this fly, so they seem to have various appetites. Some are found to place their eggs within the aurelia of some nascent insect, others place them within the nest, which the wasp had curiously contrived for its own young; and as both are produced at the same time, the young

of the ichneumon, not only devours the young wasp, but the whole supply of worms, which the parent had carefully provided for its provision. But the greatest number of the ichneumon tribe are seen settling upon the back of the caterpillar, and darting, at different intervals, their stings into its body. At every dart they deposit an egg, while the wounded animal seems scarcely sensible of the injury it sustains. In this manner they leave from six to a dozen of their eggs, within the fatty substance of the reptile's body, and then fly off to commit further depredations. In the mean time, the caterpillar thus irreparably injured, seems to feed as voraciously as before, does not abate of its usual activity; and, to all appearance, seems no way affected by the internal enemies that are preparing its destruction in their darksome abode. But they soon burst from their egg state, and begin to prey upon the substance of their prison. As they grow larger, they require a greater supply, till at last the animal, by whose vitals they are supported, is no longer able to sustain them, but dies; its whole inside being almost eaten away. It often happens, however, that it survives their worm state, and then they change into a chrysalis, enclosed in the caterpillar's body till the time of their delivery approaches, when they burst their prisons and fly away. The caterpillar, however, is irreparably destroyed, it never changes into a chrysalis, but dies shortly after, from the injuries it had sustained.

Such is the history of this fly, which, though very terrible to the insect tribe, fails not to be of infinite service to mankind. The millions which it kills in a single summer, are inconceivable; and without such a destroyer, the fruits of the earth would only rise to furnish a banquet for the insect race, to the exclusion of all the nobler ranks of animated nature.

C H A P. V.

Of the Ant.

THOUGH the number of two-winged flies be very great, and the naturalists have taken some pains to describe their characters and varieties; yet there is such a similitude in their forms and manners, that in a work like this, one description must serve for all. We now, therefore, come to a species of four-winged insects, that are famous from all antiquity, for their social and industrious habits, that are marked for their spirit of subordination, that are offered as a pattern of parsimony, to the profuse, and of unremitting diligence to the sluggard.

In the experiments, however, which have been more recently made, and the observations which have been taken, much of their boasted frugality and precaution seems denied them; the treasures they lay up, are no longer supposed intended for future provision, and the choice they make in their stores, seems no way dictated by wisdom. It is, indeed, somewhat surprizing, that almost every writer of antiquity should describe this insect as labouring in the summer, and feasting upon the produce during the winter. Perhaps, in some of the warmer climates, where the winter is mild, and of short continuance, this may take place; but in France and England, these animals can have no manner of occasion for a supply of winter provisions, as they are actually in a state of torpidity during that season.

The common ants of Europe are of two or three different kinds; some red, some black, some with stings, and others without. Such as have stings, inflict their wounds in that manner; such as are unprovided with these weapons of defence, have a power of spurting, from their hinder parts, an acid pun-

gent liquor, which, if it lights upon the skin, inflames and burns it like nettles.

The body of an ant is divided, into the head, breast and belly. In the head the eyes are placed, which are entirely black; and under the eyes, there are two small horns or feelers, composed of twelve joints, all covered with a fine silky hair. The mouth is furnished with two crooked jaws, which project outwards, in each of which are seen incisures, that look like teeth. The breast is covered with a fine silky hair, from which project six legs, that are pretty strong and hairy, the extremities of each armed with two small claws, which the animal uses in climbing. The belly is more red than the rest of the body, which is of a brown chefnut colour, shining as glass, and covered with extremely fine hair.

From such a formation, this animal seems bolder and more active, for its size, than any other of the insect tribe, and fears not to attack a creature, often above ten times its own magnitude.

As soon as the winter is past, in the first fine day in April, the ant hill, that before seemed a desert, now swarms with new life, and myriads of these insects are seen just awaked from their annual lethargy, and preparing for the pleasures and fatigues of the season. For the first day they never offer to leave the hill, which may be considered as their citadel, but run over every part of it, as if to examine its present situation, to observe what injuries it has sustained during the rigours of winter*, while they slept, and to meditate and settle the labours of the day ensuing.

At the first display of their forces, none but the wingless tribe appears, while those furnished with wings remain at the bottom. These are the working ants, that first appear, and that are always destitute of wings; the males and females, that are furnished with four large wings each, are more slow in making their appearance.

* *Memoires pour servir a l'Histoire des insectes par Charles de Geer.*

Thus, like bees, they are divided into males, females, and the neutral or the working tribe. These are all easily distinguished from each other; the females are much larger than the males; the working ants are the smallest of all. The two former have wings; which, however, they sometimes are divested of; the latter never have any, and upon them are devolved all the labours that tend to the welfare of the community. The female, also, may be distinguished, by the colour and structure of her breast, which is a little more brown, than that of the common ant, and a little brighter than that of the male.

In eight or ten days after their first appearance, the labours of the hill are in some forwardness; the males and females are seen mixed with the working multitude, and pursued or pursuing each other. They seem no way to partake in the common drudgeries of the state; the males pursue the females with great assiduity; and, in a manner, force them to compliance. They remain coupled for some time, while the males thus united, suffer themselves to be drawn along by the will of their partners.

In the mean time, the working body of the state takes no part in their pleasures: they are seen diligently going from the ant-hill, in pursuit of food for themselves and their associates, and of proper materials for giving a comfortable retreat to their young, or safety to their habitation. In the fields of England, ant-hills are formed with but little apparent regularity. In the more southern provinces of Europe, they are constructed with wonderful contrivance, and offer a sight highly worthy a naturalist's curiosity. These are generally formed in the neighbourhood of some large tree and a stream of water. The one is considered by the animals, as the proper place for getting food; the other for supplying them with moisture, which they cannot well dispense with. The shape of the ant-hill is that of a sugar loaf, about three feet high, composed of various substances; leaves, bits of wood, sand, earth, bits of gum, and grains of corn. These are all united into a compact body, perforated with galleries down to the bottom, and winding ways within the body of the structure. From this retreat, to

the water, as well as to the tree, in different directions, there are many paths worn by constant assiduity, and along these the busy insects are seen passing and repassing continually; so that from May, or the beginning of June, according to the state of the season, they work continually, till the bad weather comes on.

The chief employment of the working ants is in sustaining not only the idlers at home, but also finding a sufficiency of food for themselves. They live upon various provisions, as well of the vegetable as of the animal kind. Small insects they will kill and devour; sweets of all kinds they are particularly fond of. They seldom, however, think of their community, till they themselves are first satiated. Having found a juicy fruit, they swallow what they can, and then tearing it in pieces, carry home their load. If they meet with an insect above their match, several of them will fall upon it at once, and having mangled it, each will carry off a part of the spoil. If they meet, in their excursions, any thing that is too heavy for one to bear, and yet, which they are unable to divide, several of them will endeavour to force it along; some dragging and others pushing. If any one of them happens to make a lucky discovery, it will immediately give advice to others, and then at once, the whole republic will put themselves in motion. If in these struggles, one of them happens to be killed, some kind survivor will carry him off to a great distance, to prevent the obstructions his body might give to the general spirit of industry.

But while they are thus employed in supporting the state, in feeding abroad, and carrying in provisions to those that continue at home, they are not unmindful of posterity. After a few days of fine weather, the female ants begin to lay their eggs, and those are assiduously watched and protected by the working ants, who take upon themselves to supply whatever is wanting to the nascent animal's convenience or necessity. They are carried as soon as laid, to the safest situation, at the bottom of their hill, where they are carefully defended from cold and moisture. We are not to suppose, that those white substances

which we so plentifully find in every ant-hill, are the eggs as newly laid. On the contrary, the ant's egg is so very small, that, though laid upon a black ground, it can scarcely be discerned. The little white bodies we see, are the young animals in their maggot state, endued with life, long since freed from the egg, and often involved in a cone, which it has spun round itself, like the silk worm. The real egg when laid, if viewed through a microscope, appears smooth, polished, and shining, while the maggot is seen composed of twelve rings, and is often larger than the ant itself.

It is impossible to express the fond attachment which the working ants show to their rising progeny. In cold weather they take them in their mouths, but without offering them the smallest injury, to the very depths of their habitation, where they are less subject to the severity of the season. In a fine day they remove them, with the same care, nearer the surface, where their maturity may be assisted by the warm beams of the sun. If a formidable enemy should come to batter down their whole habitation, and crush them by thousands in the ruin, yet these wonderful insects, still mindful of their parental duties, make it their first care to save their offspring. They are seen running wildly about in different ways, each loaded with a young one, often bigger than the insect that supports it. I have kept, says Swammerdam, several of the working ants in my closet, with their young, in a glass filled with earth. I took pleasure in observing, that in proportion as the earth dried on the surface, they dug deeper and deeper to deposit their eggs; and when I poured water thereon, it was surprizing to see with what care, affection, and diligence they laboured, to put their brood in safety, in the driest place. I have seen also, that when water has been wanting for several days, and when the earth was moistened after it a little, they immediately carried their young ones to have a share, who seemed to enjoy and suck the moisture.

When the young maggot is come to its full growth, the breast swells insensibly, it casts its skin, and loses all motion.

All the members which were hidden before, then begin to appear; an aurelia is formed, which represents very distinctly, all the parts of the animal, though they are yet without motion, and, as it were, wrapped up in swaddling-clothes. When, at length, the little insect has passed through all its changes, and acquired its proper maturity, it bursts this last skin, to assume the form it is to retain ever after. Yet this is not done by the efforts of the little animal alone, for the old ones very assiduously break open, with their teeth, the covering in which it is enclosed. Without this assistance, the aurelia would never be able to get free, as mr. De Geer often found, who tried the experiment, by leaving the aurelia to themselves. The old ones not only assist them, but know the very precise time for lending their assistance, for if produced too soon, the young one dies of cold; if retarded too long, it is suffocated in its prison.

When the female has done laying, and the whole brood is thus produced, her labours, as well as that of the male, become unnecessary, and her wings, which she had but a short time before so actively employed, drop off. What becomes of her when thus divested of her ornaments is not well known, for she is seen in the cells for some weeks after. The males, on the other hand, having no longer any occupation at home, make use of those wings with which they have been furnished by nature; and fly away, never to return, or to be heard of more. It is probable they perish with the cold, or are devoured by the birds, which are particularly fond of this petty prey.

In the mean time, the working ants having probably deposed their queens, and being deserted by the males, that served but to clog the community, prepare for the severity of the winter, and bury their retreats as deep in the earth as they conveniently can. It is now found that the grains of corn, and other substances with which they furnish their hill, are only meant as fences to keep off the rigours of the weather, not as provisions to support them during its continuance. It is found generally to obtain, that every insect that lives a year after it is come to its full growth, is obliged to pass four or five months with-

out taking any nourishment, and will seem to be dead all that time. It would be to no purpose therefore for ants to lay up corn for the winter, since they lie that time without motion, heaped upon each other, and are so far from eating, that they are utterly unable to stir. Thus, what authors have dignified by the name of a magazine, appears to be no more than a cavity, which serves for a common retreat when the weather forces them to return to their lethargic state.

What has been said with exaggeration of the European ant, is however true, if asserted of those of the tropical climates. They build an ant-hill with great contrivance and regularity, they lay up provisions, and, as they probably live the whole year, they submit themselves to regulations entirely unknown among the ants of Europe.

Those of Africa are of three kinds, the red, the green, and the black; the latter are above an inch long, and in every respect a most formidable insect. Their sting produces extreme pain, and their depredations are sometimes extremely destructive. They build an ant-hill of a very great size, from six to twelve feet high; it is made of viscous clay, and tapers into a pyramidal form. This habitation is constructed with great artifice, and the cells are so numerous and even, that a honeycomb scarce exceeds them in number and regularity.

The inhabitants of this edifice seem to be under a very strict regulation. At the slightest warning, they will sally out upon whatever disturbs them, and if they have time to arrest their enemy, he is sure to find no mercy. Sheep, hens, and even rats are often destroyed by these merciless insects, and their flesh devoured to the bone. No anatomist in the world can strip a skeleton so cleanly as they, and no animal, how strong soever, when they have once seized upon it, has power to resist them.

It often happens that these insects quit their retreat in a body, and go in quest of adventures. "During my stay," says Smith, "at Cape Corse Castle, a body of these ants came to

pay us a visit in our fortification. It was about day-break when the advanced guard of this famished crew entered the chapel, where some negroe servants were asleep upon the floor. The men were quickly alarmed at the invasion of this unexpected army, and prepared, as well as they could, for a defence. While the foremost battalion of insects had already taken possession of the place, the rear-guard was more than a quarter of a mile distant. The whole ground seemed alive, and crawling with unceasing destruction. After deliberating a few moments upon what was to be done, it was resolved to lay a large train of gunpowder along the path they had taken. By this means millions were blown to pieces, and the rear guard perceiving the destruction of their leaders, thought proper instantly to return, and make back to their original habitation."

The order which these ants observe, seems very extraordinary; whenever they fall forth, fifty or sixty larger than the rest are seen to head the band, and conduct them to their destined prey. If they have a fixed spot, where their prey continues to resort, they form a vaulted gallery, which is sometimes a quarter of a mile in length, and yet, they will hollow it out in the space of ten or twelve hours.

C H A P. VI.

Of the Beetle and its Varieties.

HITHERTO we have been treating of insects with four transparent wings; we now come to a tribe with two transparent wings, with cases that cover them close while at rest, but which allow them their proper play when flying. The principal of these are the beetle, the May-bug, and the cantharis. These are all bred like the rest of their order, first from eggs, then they become grubs, then a chrysalis, in

Rhinoceros Beetle



Flying Stag Bee



Flying Bull Bee



Elephant Bee



Cuttle Fish





which the parts of the future fly are distinctly seen, and lastly the animal leaves its prison, breaking forth as a winged animal in full maturity.

Of the beetle there are various kinds ; all, however, concurring in one common formation, of having cases to their wings, which are the more necessary to those insects, as they often live under the surface of the earth in holes, which they dig out by their own industry. These cases prevent the various injuries their real wings might sustain, by rubbing or crushing against the sides of their abode. These, though they do not assist flight, yet keep the internal wings clean and even, and produce a loud buzzing noise, when the animal rises in the air.

If we examine the formation of all animals, of the beetle kind, we shall find, as in shell-fish, that their bones are placed externally, and their muscles within. These muscles are formed very much like those of quadrupeds, and are endued with such surprising strength, that bulk for bulk, they are a thousand times stronger than those of a man. The strength of these muscles is of use in digging the animal's subterraneous abode, where it is most usually hatched, and to which it most frequently returns, even after it becomes a winged insect, capable of flying.

Beside the difference which results from the shape and colour of these animals, the size also makes a considerable one ; some beetles being not larger than the head of a pin, while others, such as the elephant beetle, are as big as one's fist : But the greatest difference among them is, that some are produced in a month, and in a single season go through all the stages of their existence, while others take near four years to their production, and live as winged insects a year more. To give the history of all these animals, that are bred pretty much in the same way, would be insipid and endless ; it will suffice to select one or two from the number, the origin of which may serve as specimens of the rest. I will, therefore, offer the history of the May-bug to the reader's attention ; premising, that most other beetles, though not so long lived, are bred in the same manner.

The May-bug, or dorr-beetle, as some call it, has, like all the rest, a pair of cases to its wings, which are of a reddish brown colour, sprinkled with a whitish dust, which easily comes off. In some years their necks are seen covered with a red plate, and in others, with a black; these, however, are distinct sorts, and their difference is by no means accidental. The fore legs are very short, and the better calculated for burrowing in the ground, where this insect makes its retreat. It is well known for its evening buzz to children; but still more formidably introduced to the acquaintance of husbandmen and gardeners; for in some seasons, it has been found to swarm in such numbers, as to eat up every vegetable production.

The two sexes in the May-bug, are easily distinguished from each other, by the superior length of the tufts, at the end of the horns, in the male. They begin to copulate in summer, and at that season, they are seen joined together for a considerable time. The female being impregnated, quickly falls to boring a hole into the ground, where to deposit her burthen. This is generally about half a foot deep, and in it she places her eggs, which are of an oblong shape, with great regularity, one by the other. They are of a bright yellow colour, and no way wrapped up in a common covering, as some have imagined. When the female is lightened of her burthen, she again ascends from her hole, to live as before, upon leaves and vegetables, to buzz in the summer evening, and to lie hid, among the branches of trees, in the heat of the day.

In about three months after these eggs have been thus deposited in the earth, the contained insect begins to break its shell, and a small grub or maggot crawls forth, and feeds upon the roots of whatever vegetable it happens to be nearest. All substances, of this kind, seem equally grateful, yet it is probable the mother insect has a choice among what kind of vegetables she shall deposit her young. In this manner these voracious creatures continue in the worm state, for more than three years, devouring the roots of every plant they approach, and making their way under ground, in quest of food, with great

dispatch and facility. At length they grow to above the size of a walnut, being a great thick white maggot with a red head, which is seen most frequently in new turned earth, and which is so eagerly sought after by birds of every species. When largest, they are found an inch and a half long, of a whitish yellow colour, with a body consisting of twelve segments or joints, on each side of which, there are nine breathing holes, and three red feet. The head is large, in proportion to the body, of a reddish colour, with a pincer before, and a semi-circular lip, with which it cuts the roots of plants, and sucks out their moisture. As this insect lives entirely under ground, it has no occasion for eyes, and accordingly it is found to have none; but it is furnished with two feelers, which, like the crutch of a blind man, serve to direct its motions. Such is the form of this animal, that lives for years in the worm state under ground, still voracious, and every year changing its skin.

It is not till the end of the fourth year, that this extraordinary insect prepares to emerge from its subterraneous abode, and even this is not effected, but by a tedious preparation. About the latter end of autumn, the grub begins to perceive the approaches of its transformation; it then buries itself deeper and deeper in the earth, sometimes six feet beneath the surface, and there forms itself a capacious apartment, the walls of which it renders very smooth and shining, by the excretions of its body. Its abode being thus formed, it begins soon after, to shorten itself, to swell, and to burst its last skin, in order to assume the form of a chrysalis. This, in the beginning, appears of a yellowish colour, which heightens by degrees, till at last, it is seen nearly red. Its exterior form plainly discovers all the vestiges of the future winged insect, all the fore parts being distinctly seen; while behind, the animal seems as if wrapped in swaddling clothes.

The young May-bug continues in this state for about three months longer, and it is not till the beginning of January, that the aurelia divests itself of all its impediments, and becomes a winged insect, completely formed. Yet still the animal is far

from attaining its natural strength, health, and appetie. It undergoes a kind of infant imbecility, and unlike most other insects, that the instant they become flies, are arrived at their state of full perfection, the May-bug continues feeble and sickly. Its colour is much brighter than in the perfect animal, all its parts are soft, and its voracious nature seems for a while, to have entirely forsaken it. As the animal is very often found in this state, it is supposed, by those unacquainted with its real history, that the old ones, of the former season, have buried themselves for the winter, in order to revisit the sun the ensuing summer. But the fact is, the old one never survives the season, but dies, like all the other winged tribe of insects, from the severity of cold in winter.

About the latter end of May, these insects, after having lived for four years under ground, burst from the earth, when the first mild evening invites them abroad. They are at that time seen rising from their long imprisonment, from living only upon roots, and imbibing only the moisture of the earth, to visit the mildness of the summer air, to choose the sweetest vegetables for their banquet, and to drink the dew of the evening. Wherever an attentive observer then walks abroad, he will see them bursting up before him in his pathway, like ghosts on a theatre. He will see every part of the earth, that had its surface beaten into hardness, perforated by their egression. When the season is favourable for them, they are seen by myriads buzzing along, hitting against every object that intercepts their flight. The mid-day sun, however, seems too powerful for their constitutions; they then lurk under the leaves and branches of some shady tree; but the willow seems, particularly, their most favourite food; there they lurk in clusters, and seldom quit the tree till they have devoured all its verdure. In those seasons, which are favourable to their propagations, they are seen in an evening as thick as flakes of snow, and hitting against every object with a sort of capricious blindness. Their duration, however, is but short, as they never survive the season. They begin to join shortly after they have been let loose from their prison, and when the female is impregnated, she

cautiously bores a hole in the ground, with an instrument fitted for that purpose, which she is furnished with at the tail, and there deposits her eggs, generally to the number of three-score. If the season and the soil be adapted to their propagation, these soon multiply as already described, and go through the noxious stages of their contemptible existence. This insect, however, in its worm state, though prejudicial to man, makes one of the chief repasts of the feathered tribe, and is generally the first nourishment with which they supply their young. Rooks, and hogs are particularly fond of these worms, and devour them in great numbers. The inhabitants of the country of Norfolk, some time since, went into the practice of destroying their rookeries; but in proportion as they destroyed one plague, they were pestered with greater; and these insects multiplied in such an amazing abundance, as to destroy not only the verdure of the fields, but even the roots of vegetables, not yet shot forth. One farm in particular was so injured by them in the year 1751, that the occupier was not able to pay his rent, and the landlord was not only content to lose his income for that year, but also gave money for the support of the farmer and his family. In Ireland they suffered so much by these insects, that they came to a resolution of setting fire to a wood, of some miles in extent, to prevent their mischievous propagation.

Of all the beetle kind, this is the most numerous, and therefore deserves the chief attention of history. The numerous varieties of other kinds, might repay the curiosity of the diligent observer, but we must be content in general to observe, that in the great out-lines of the history, they resemble those of which we have just been giving a description; like them, all other beetles are bred from the egg, which is deposited in the ground; or sometimes, tho' seldom, in the barks of trees, they change into a worm; they subsist in that state by living upon the roots of vegetables, or the succulent parts of the bark round them. They generally live a year at least before they change into an aurelia; in that state they are not entirely motionless nor entirely swaddled up without form.

It would be tedious and endless to give a description of all, and yet it would be an unpardonable omission not to mention the particularities of some beetles which are singular rather from their size, their manners, or their formation. That beetle which the Americans call the tumble-dung, particularly demands our attention; it is all over of a dusky black, rounder than those animals are generally found to be, and so strong, though not much larger than the common black beetle, that if one of them be put under a brass candlestick, it will cause it to move backwards and forwards, as if it were by an invisible hand, to the admiration of those who are not accustomed to the sight; but this strength is given it for much more useful purposes than those of exciting human curiosity; for there is no creature more laborious, either in seeking subsistence, or in providing a proper retreat for its young. They are endowed with sagacity to discover subsistence by their excellent smelling, which directs them in flights to excrements just fallen from man or beast, on which they instantly drop, and fall unanimously to work in forming round balls or pellets thereof, in the middle of which they lay an egg. These pellets, in September, they convey three feet deep in the earth, where they lie till the approach of spring, when the eggs are hatched, the nests burst, and the insects find their way out of the earth. They assist each other with indefatigable industry, in rolling these globular pellets to the place where they are to be buried. This they are to perform with the tail foremost, by raising up their hinder part, and shoving along the ball with their hind-feet. They are always accompanied with other beetles of a larger size, and of a more elegant structure and colour. The breast of this is covered with a shield of a crimson colour, and shining like metal; the head is of the like colour, mixed with green, and on the crown of the head stands a shining black horn, bended backwards. These are called the kings of the beetles, but for what reason is uncertain, since they partake of the same dirty drudgery with the rest.

The elephant-beetle is the largest of this kind hitherto known, and is found in South-America, particularly Guiana

and Surinam, as well as about the river Oroonoko. It is of a black colour, and the whole body is covered with a very hard shell, full as thick and as strong as that of a small crab. Its length, from the hinder part to the eyes, is almost four inches, and from the same part to the end of the proboscis, or trunk, four inches and three quarters. The transverse diameter of the body is two inches and a quarter, and the breadth of each elytron, or case for the wings, is an inch and three-tenths. The antennæ or feelers, are quite horny; for which reason the proboscis or trunk is moveable at its insertion into the head, and seems to supply the place of feelers. The horns are eight-tenths of an inch long, and terminate in points. The proboscis is an inch and a quarter long, and turns upwards, making a crooked line, terminating in two horns, each of which is near a quarter of an inch long; but they are not perforated at the end like the proboscis of other insects. About four-tenths of an inch above the head, or that side next the body, is a prominence or small horn, which, if the rest of the trunk were away, would cause this part to resemble the horn of a rhinoceros. There is indeed a beetle so called, but then the horns or trunk has no fork at the end, though the lower horn resembles this. The feet are all forked at the end, but not like lobsters' claws.

To this class we may also refer the glow-worm, that little animal which makes such a distinguished figure in the descriptions of our poets. No two insects can differ more than the male and female of this species from each other. The male is in every respect a beetle, having cases to its wings, and rising in the air at pleasure; the female, on the contrary, has none, but is entirely a creeping insect, and is obliged to wait the approaches of her capricious companion. The body of the female has eleven joints, with a shield breast-plate, the shape of which is oval; the head is placed over this, and is very small, and the three last joints of her body are of a yellowish colour; but what distinguishes it from all other animals, at least in this part of the world, is the shining light which it emits by night, and which is supposed by some philosophers, to be an emanation which she sends forth to allure the male to her company.

Most travellers who have gone through sandy countries, must well remember the little shining sparks with which the ditches are studded on each side of the road. If incited by curiosity to approach more nearly, he will find the light sent forth by the glow-worm : if he should keep the little animal for some time, its light continues to grow paler, and at last appears totally extinct : the manner in which this light is produced has hitherto continued inexplicable ; it is probable the little animal is supplied with some electrical powers, so that by rubbing the joints of its body against each other, it thus supplies a stream of light, which, if it allures the male, as we are told, serves for very useful purposes.

The cantharis is of the beetle kind, from whence come cantharides, well known in the shops by the name of Spanish flies, and for their use in blisters. They have feelers like bristles, flexible cases to the wings, a breast pretty plain, and the sides of the belly wrinkled. Cantharides differ from each other in their size, shape, and colour, those used in the shops also do the same. The largest in these parts are about an inch long, and as much in circumference, but others are not above three quarters of an inch. Some are of a pure azure colour, others of pure gold, and others again, have a mixture of pure gold and azure colours ; but they are all very brilliant, and extremely beautiful. These insects, as is well known, are of the greatest benefit to mankind, making a part in many medicines conducive to human preservation. They are chiefly natives of Spain, Italy, and Portugal ; but they are to be met with also about Paris in the summer time, upon the leaves of the ash, the poplar, and the rose-trees, and also among wheat, and in meadows. It is very certain, that these insects are fond of ash leaves, insomuch, that they will sometimes strip one of these trees quite bare. Some affirm, that these flies delight in sweet-smelling herbs, and it is very certain, that they are fond of honey-suckles, lilach, and wild cherry shrubs ; but some that have sought after them declare, they never could find them on elder-trees, nut trees, and among wheat. We are told, that the country people expect the return of these

insects every seven years. It is very certain, that such a number of these insects have been seen together in the air, that they appeared like swarms of bees; and that they have so disagreeable a smell, that it may be perceived a great way off, especially about sun-set, though they are not seen at that time. This bad smell is a guide for those who make it their business to catch them. When they are caught, they dry them, after which they are so light, that fifty will hardly weigh a drachm. Those that gather them tie them in a bag, or a piece of linen cloth, that has been well worn, and then they kill them with the vapours of hot vinegar, after which they dry them in the sun, and keep them in boxes. These flies, thus dried, being chemically analysed, yield a great deal of volatile caustic-salt, mixed with a little oil, phlegm and earth. Cantharides are penetrating, corrosive, and applied to the skin, raise blisters, from whence proceeds a great deal of serosity. They are made use of both inwardly and outwardly. However, it is somewhat strange that the effects of these flies should fall principally upon the urinary passages; but though some authors have endeavoured to account for this, we are still in the dark, for all they have said amounts to no more, than that they affect these parts in a manner which may be very learnedly described, but very obscurely comprehended.

An insect of great, though perhaps not equal use in medicine, is that which is known by the name of the kermes; it is produced in the excrescence of an oak, called the berry-bearing ilex, and appears at first wrapt up in a membranaceous bladder, of the size of a pea, smooth and shining, of a brownish red colour, and covered with a very fine ash-coloured powder. This bag teems with a number of reddish eggs or insects, which, being rubbed with the fingers, pour out a crimson liquor. It is only met with in warm countries in the months of May and June. In the month of April, this insect becomes of the size and shape of a pea, and its eggs some time after burst from the womb, and soon turning worms, run about the branches and leaves of the tree. They are of two sexes, and the females have been hitherto described; but the

males are very distinct from the former, and are a sort of small flies, like gnats, with six feet, of which the four forward are short, and the two backward long, divided into four joints, and armed with three crooked nails. There are two feelers on the head, a line and a half long, which are moveable, streaked and articulated. The tail, at the back part of the body, is half a line long, and forked. The whole body is covered with two transparent wings, and they leap about in the manner of fleas. The harvest of the kermes is greater or less in proportion to the severity of the winter, and the women gather them before sunrise, tearing them off with their nails; for fear there should be any loss from the hatching of the insects. They sprinkle them with vinegar, and lay them in the sun to dry, where they acquire a red colour.

An insect, perhaps, still more useful than either of the former, is the cochineal, which has been very variously described by authors; some have supposed it a vegetable excrescence from the tree upon which it is found; some have described it as a louse, some as a bug, and some as a beetle. As they appear in our shops when brought from America, they are of an irregular shape, convex on one side, and a little concave on the other; but are both marked with transverse streaks or wrinkles. They are of a scarlet colour within, and without of a blackish red, and sometimes of a white, reddish, or ash-colour, which are accounted the best, and are brought to us from Mexico. The cochineal insect is of an oval form, of the size of a small pea, with six feet, and a snout or trunk. It brings forth its young alive, and is nourished by sucking the juice of the plant. Its body consists of several rings, and when it is once fixed on the plant, it continues immoveable, being subject to no change. Some pretend there are two sorts, the one domestic, which is best, and the other wild, that is of a vivid colour; however, they appear to be the same, only with this difference, that the wild feeds upon uncultivated trees, without any assistance, whereas the domestic is carefully, at a stated season, removed to cultivated trees, where it feeds upon a purer juice. Those who take care of these insects, place them

on the prickly pear-plant in a certain order, and are very industrious in defending them from other insects; for if any other kind come among them, they take care to brush them off with foxes tails. Towards the end of the year, when the rains and cold weather are coming on, which are fatal to these insects, they take off the leaves or branches covered with cochineal, that have not attained their utmost degree of perfection, and keep them in their houses till winter is past. These leaves are very thick and juicy, and supply them with sufficient nourishment, while they remain within doors. When the milder weather returns, and these animals are about to exclude their young, the natives make them nests, like those of birds, but less, of tree-moss, or soft hay, or the down of cocoa-nuts, placing twelve in every nest. These they fix on the thorns of the prickly pear-plant, and in three or four days time they bring forth their young, which leave their nests in a few days, and creep upon the branches of the plant, till they find a proper place to rest in, and take in their nourishment; and until the females are fecundated by the males, which, as in the former tribe, differ very widely from the females, being winged insects, whereas the others only creep, and are at most stationary. When they are impregnated, they produce a new offspring, so that the propagator has a new harvest thrice a year. When the native Americans have gathered the cochineal, they put them into holes in the ground, where they kill them with boiling water, and afterwards dry them in the sun, or in an oven, or lay them upon hot plates. From the various methods of killing them, arise the different colours which they appear in when brought to us. While they are living, they seem to be sprinkled over with a white powder, which they lose as soon as the boiling water is poured upon them. Those that are dried upon hot plates are the blackest. What we call the cochineal are only the females, for the males are a sort of a fly, as already observed in the kermes. They are used both for dying and medicine, and are said to have much the same virtue as the kermes, tho' they are now seldom used alone, but are mixed with other things for the sake of the colour.

I shall end this account of the beetle tribe with the history of an animal which cannot properly be ranked under this species, and yet which cannot be more methodically ranged under any other. This is the insect that forms and resides in the gall-nut, the spoils of which are converted to such useful purposes. The gall insects are bred in a sort of bodies adhering to a kind of oak in Asia, which differ with regard to their colour, size, roughness, smoothness and shape, and which we call galls. They are not fruit, as some have imagined, but preternatural tumours, owing to the wounds given to the buds, leaves, and twigs of the tree, by a kind of insects that lay their eggs within them. This animal is furnished with an implement, by which the female penetrates into the bark of the tree, or into that spot which just begins to bud, and there sheds a drop of corrosive fluid into the cavity. Having thus formed a receptacle for her eggs, she deposits them in the place, and dies soon after. The heart of the bud being thus wounded, the circulation of the nutritive juice is interrupted and the fermentation thereof, with poison injected by the fly, burns the parts adjacent, and then alters the natural colour of the plant. The juice or sap turned back from its natural course, extravasates and flows round the egg. After which it swells and dilates by the assistance of some bubbles of air, which get admission through the pores of the bark, and which run in the vessels with the sap. The external coat of this excrescence is dried by the air, and grows into a figure which bears some resemblance to the bow of an arch, or the roundness of a kernel. This little ball receives its nutriment, growth and vegetation as the other parts of the tree, by slow degrees, and is what we call the gall-nut. The worm that is hatched under this spacious vault, finds in the substance of the ball, which is as yet very tender, a subsistence suitable to its nature; gnaws and digests it till the time comes for its transformation to a nymph, and from that state of existence changes into a fly. After this, the insect, perceiving itself duly provided with all things requisite, disengages itself soon from its confinement, and takes its flight into the open air. The case, however, is not similar with respect

to the gall-nut, that grows in autumn. The cold weather frequently comes on before the worm is transformed into a fly, or before the fly can pierce through its inclosure. The nut falls with the leaves, and altho' you may imagine that the fly which lies within is lost, yet, in reality, it is not so; on the contrary, its being covered up so close, is the means of its preservation. Thus it spends the winter in a warm house, where every crack and cranny of the nut is well stopped up; and lies buried, as it were, under a heap of leaves, which preserves it from the injuries of the weather. This apartment, however, tho' so commodious a retreat in the winter, is a perfect prison in the spring. The fly, roused out of its lethargy by the first heats, breaks its way through, and ranges where it pleases. A very small aperture is sufficient, since at this time the fly is but a diminutive creature. Besides, the ringlets whereof its body is composed, dilate, and become pliant in the passage.

C H A P. VII.

Of the Gnat and Tipula.

THERE are two insects which entirely resemble each other in their form, and yet widely differ in their habits, manners and propagation. Those who have seen the tipula, or long-legs, and the larger kind of gnat, have most probably mistaken the one for the other: they have often accused the tipula, a harmless insect, of depredations made by the gnat, and the innocent have suffered for the guilty; indeed, the differences in their form are so very minute, that it often requires the assistance of a microscope to distinguish the one from the other: they are both mounted on long legs, both furnished with two wings and a slender body; their heads are large, and they seem to be hump-backed; the chief and only difference, therefore, is, that the tipula wants a trunk, while the gnat has

a large one, which it often exerts to very mischievous purposes. The tipula is a harmless peaceful insect, that offers injury to nothing; the gnat is sanguinary and predaceous, ever seeking out for a place in which to bury its trunk, and pumping up the blood from the animal in large quantities.

The gnat proceeds from a little worm, which is usually seen at the bottom of standing waters. The manner in which the insect lays its eggs is particularly curious; after having laid the proper number on the surface of the water, it surrounds them with a kind of unctuous matter, which prevents them from sinking; but, at the same time, fastens them with a thread to the bottom, to prevent their floating away, at the mercy of every breeze, from a place the warmth of which is proper for their production, to any other, where the water may be too cold, or the animals its enemies too numerous. Thus the insects, in their egg state, resemble a buoy, which is fixed by an anchor. As they come to maturity they sink deeper, and at last, when they leave the egg as worms they creep at the bottom. They now make themselves lodgments of cement, which they fasten to some solid body at the very bottom of the water, unless, by accident, they meet with a piece of chalk, which being of a soft and pliant nature, gives them an opportunity of sinking a retreat for themselves, where nothing but the claws of a cray-fish can possibly molest them. The worm afterwards changes its form. It appears with a large head, and a tail invested with hair, and moistened with an oleaginous liquor, which she makes use of as a cork, to sustain her head in the air, and her tail in the water, and to transport her from one place to another. When the oil with which her tail is moistened begins to grow dry, she discharges out of her mouth an unctuous humour, which she sheds all over her tail, by virtue whereof, she is enabled to transport herself where she pleases, without being either wet or any ways incommoded by the water. The gnat in her second state, is, properly speaking, in her form of a nymph, which is an introduction, or entrance into a new life. In the first place, she divests herself of her second skin; in the next she resigns her eyes, her antennæ, and her

tail; in short, she actually seems to expire. However, from the spoils of the amphibious animal, a little winged insect cuts the air, whose every part is active to the last degree, and whose whole structure is the just object of our admiration. Its little head is adorned with a plume of feathers, and its whole body invested with scales and hair, to secure it from any wet or dust. She makes trial of the activity of her wings, by rubbing them either against her body, or her broad side-bags, which keep her in an equilibrium. The furbelow, or little border of fine feathers, which graces her wings, is very curious, and strikes the eye in the most agreeable manner. There is nothing, however, of greater importance to the gnat, than her trunk, and that weak implement may justly be deemed one of nature's master-pieces. It is so very small, that the extremity of it can scarcely be discerned through the best microscope that can be procured. That part which is at first obvious to the eye, is nothing but a long scaly sheath under the throat. At near the distance of two thirds of it, there is an aperture, through which the insect darts out four stings, and afterwards retracts them. One of which, however sharp and active it may be, is no more than the case in which the other three lie concealed, and run in a long groove. The sides of these stings are sharpened like two-edged swords; they are likewise barbed, and have a vast number of cutting teeth towards the point, which turns up like a hook, and is fine beyond expression. When all these darts are stuck into the flesh of animals, sometimes one after another, and sometimes all at once, the blood and humours of the adjacent parts must unavoidably be extravasated; upon which a tumour must consequently ensue, the little orifice whereof is closed up by the compression of the external air. When the gnat, by the point of her case, which she makes use of as a tongue, has tasted any fruit, flesh, or juice, that she has found out; if it be a fluid, she sucks it up, without playing her darts into it; but in case she finds the least obstruction by any flesh whatever, she exerts her strength, and pierces through it, if possibly she can. After this she draws back her stings into their sheath, which she applies to the

wound in order to extract, as through a reed, the juices which she finds inclosed. This is the implement with which the gnat performs her work in the summer, for during the winter she has no manner of occasion for it. Then she ceases to eat, and spends all that tedious season either in quarries or in caverns, which she abandons at the return of summer, and flies about in search after some commodious ford, or standing water, where she may produce her progeny, which would be soon washed away and lost, by the too-rapid motion of any running stream. The little brood are sometimes so numerous, that the very water is tinged according to the colour of the species, as green, if they be green, and of a sanguine hue, if they be red.

These are circumstances sufficiently extraordinary in the life of this little animal, but it offers something still more curious in the method of its propagation. However similar insects of the gnat kind are in their appearance, yet they differ widely from each other in the manner in which they are brought forth, for some are oviparous, and are produced from eggs, some are viviparous, and come forth in their most perfect form; some are males, and unite with the female; some are females, requiring the impregnation of the male; some are of neither sex, yet still produce young, without any copulation whatsoever. This is one of the strangest discoveries in all natural history! A gnat separated from the rest of its kind, and inclosed in a glass vessel, with air sufficient to keep it alive, shall produce young, which also, when separated from each other, shall be the parents of a numerous progeny. Thus, down for five or six generations do these extraordinary animals propagate without the use of copulation, without any congress between the male and female, but in the manner of vegetables, the young bursting from the body of their parents, without any previous impregnation. At the sixth generation however, their propagation stops, the gnat no longer produces its like, from itself alone, but it requires the access of the male to give it another succession of fecundity.

The gnat of Europe gives but little uneasiness; it is some-

times heard to hum about our beds at night, and keeps off the approaches of sleep by the apprehension it causes; but it is very different in the ill-peopled regions of America, where the waters stagnate and the climate is warm, and where they are produced in multitudes beyond expression. The whole air is there filled with clouds of those famished insects; and they are found of all sizes, from six inches long, to a minuteness that even requires the microscope to have a distinct perception of them. The warmth of the mid-day sun is too powerful for their constitutions; but when the evening approaches, neither art nor flight can shield the wretched inhabitants from their attacks, though millions are destroyed, still millions more succeed, and produce unceasing torment. The native Indians, who anoint their bodies with oil, and who have from their infancy been used to their depredations, find them much less inconvenient than those who are newly arrived from Europe; they sleep in their cottages covered all over with thousands of the gnat kind upon their bodies, and yet do not seem to have their slumbers interrupted by their cruel devourers. If a candle happens to be lighted in one of those places, a cloud of insects at once light upon the flame, and extinguish it; they are therefore obliged to keep their candles in glass lanthorns; a miserable expedient to prevent an unceasing calamity.

P A R T. V.

C H A P. I.

Of Zoophytes in General.

WE are now come to the last link in the chain of animated nature, to a class of beings so confined in their powers, and so defective in their formation, that some historians have been at a loss whether to consider them as a superior rank of vegetables, or the humblest order of the animated tribe. In order therefore to give them a denomination, agreeable to their existence, they have been called zoophytes, a name implying vegetable nature endued with animal life; and indeed, in some the marks of the animal are so few, that it is difficult to give their place in nature with precision, or to tell whether it is a plant or an insect that is the object of our consideration.

Should it be asked what is that constitutes the difference between animal and vegetable life, what it is that lays the line that separates those two great kingdoms from each other, it would be difficult, perhaps we should find it impossible, to return an answer. The power of motion cannot form this distinction, since some vegetables are possessed of motion, and many animals are totally without it. The sensitive plant has obviously a greater variety of motions than the oyster or the pholas. The animal that fills the acorn-shell is immoveable, and can only close its lid to defend itself from external injury, while the flower, which goes by the name of the fly-trap, seems to close upon the flies that light upon it, and that attempt to rifle it of its honey. The animal in this instance, seems to have scarce a power of self-defence; the vegetable not only guards its possessions, but seizes upon the robber that would

venture to invade them. In like manner, the methods of propagation give no superiority to the lower rank of animals. On the contrary, vegetables are frequently produced more conformably to the higher ranks of the creation, and though some plants are produced by cuttings from others, yet the general manner of propagation is from seeds, laid in the womb of the earth, where they are hatched into the similitude of the parent plant or flower. But a most numerous tribe of animals have lately been discovered, which are propagated by cuttings, and this in so extraordinary a manner, that, though the original insect be divided into a thousand parts, each, however small, shall be formed into an animal, entirely resembling that which was at first divided; in this respect, therefore, certain races of animals seem to fall beneath vegetables, by their more imperfect propagation.

What, therefore, is the distinction between them, or are the orders so intimately blended as that it is impossible to mark the boundaries of each? To me it would seem, that all animals are possessed of one power, of which vegetables are totally deficient; I mean either the actual ability, or an awkward attempt at self-preservation. However vegetables may seem possessed of this important quality, yet it is with them but a mechanical impulse, resembling the raising one end of the lever, when you depress the other; the sensitive plant contracts and hangs its leaves, indeed, when touched, but this motion no way contributes to its safety; the fly-trap flower acts entirely in the same manner; and though it seems to seize the little animal, that comes to annoy it, yet in reality, only closes mechanically upon it, and this inclosure neither contributes to its preservation nor its defence. But it is very different with insects, even of the lowest order; the earth-worm not only contracts, but hides itself in the earth, and escapes with some share of swiftness from its pursuers. The polypus hides its horns; the star-fish contracts its arms, upon the appearance even of distant dangers; they not only hunt for their food, but provide for their safety, and however imperfectly they may be formed, yet still they are in reality, placed many degrees

above the highest vegetable of the earth, and are possessed of many animal functions, as well as those that are more elaborately formed.

But though these be superior to plants, they are very far beneath their animated fellows of existence. In the class of zoophytes, we may place all those animals, which may be propagated by cuttings, or in other words, which, if divided into two or more parts, each part in time becomes a separate and perfect animal; the head shoots forth a tail, and on the contrary, the tail produces a head; some of these will bear dividing, but into two parts, such is the earth-worm; some may be divided into more than two, and of this kind are many of the star-fish; others still may be cut into a thousand parts, each becoming a perfect animal; they may be turned inside out, like the finger of a glove; they may be moulded into all manner of shapes, yet still their vivacious principle remains, still every single part becomes perfect in its kind, and after a few days existence, exhibits all the arts and industry of its contemptible parent! We shall, therefore, divide zoophytes according to their several degrees of perfection, namely, into worms, star-fish and polipy; contenting ourselves with a short review of those nauseous and despicable creatures, that excite our curiosity chiefly by their imperfections; it must not be concealed, however, that much has of late been written on this part of natural history. A new mode of animal production could not fail of exciting not only the curiosity, but the astonishment of every philosopher; many found their favourite systems totally overthrown by the discovery, and it was not without a wordy struggle, that they gave up what had formerly been their pleasure and their pride. At last, however, conviction became too strong for argument, and a question, which owed its general spread rather to its novelty, than to its importance, was given up in favour of the new discovery.

C H A P. II.

Of Worms.

THE first in the class of zoophytes, are animals of the worm kind, which being entirely destitute of feet, trail themselves along upon the ground, and find themselves a retreat under the earth, or in the water. As these, like serpents, having a creeping motion, so both, in general, go under the common appellation of reptiles ; a loathsome, noxious, malignant tribe, to which man by nature, as well as by religion, has the strongest antipathy. But though worms, as well as serpents, are mostly without feet, and have been doomed to creep along the earth on their bellies, yet their motions are very different. The serpent, as has been said before, having a back-bone, which it is incapable of contracting, bends its body into the form of a bow, and then shoots forward from the tail ; but it is very different with the worm, which has a power of contracting or lengthening itself at will. There is a spiral muscle, that runs round its whole body, from the head to the tail, somewhat resembling a wire wound round a walking-cane, which when slipped off, and one end extended and held fast, will bring the other nearer to it ; in this manner the earth-worm, having shot out, or extended its body, takes hold by the slime of the fore-part of its body, and so contracts and brings forward the hinder part ; in this manner it moves onward, not without great effort, but the occasions for its progressive motion are few.

As it is designed for living under the earth, and leading a life of obscurity, so it seems tolerably adapted to its situation. Its body is armed with small stiff sharp burrs or prickles, which it can erect or depress at pleasure ; under the skin there lies a slimy juice, to be ejected as occasion requires, at certain perforations, between the rings of the muscles, to lubricate its body, and facilitate its passage into the earth. Like most other in-

fects, it hath breathing-holes along the back, adjoining each ring; but it is without bones, without eyes, without ears, and, properly, without feet. It has a mouth, and also an elementary canal, which runs along to the very point of the tail. In some worms, however, particularly such as are found in the bodies of animals, this canal opens towards the middle of the belly at some distance from the tail. The intestines of the earth-worm are always found filled with a very fine earth, which seems to be the only nourishment these animals are capable of receiving.

The animal is entirely without brain, but near the head is placed the heart, which is seen to beat with a very distinct motion, and round it are the spermatic vessels forming a number of little globules, containing a milky fluid, which have an opening into the belly, not far from the head : they are also often found to contain a number of eggs, which are laid in the earth, and are hatched in twelve or fourteen days into life, by the genial warmth of their situation ; like snails, all these animals unite in themselves, both sexes at once, the reptile that impregnates, being impregnated in turn ; few that walk out, but must have observed them with their heads laid against each other, and so strongly attached that they suffer themselves to be trod upon.

When the eggs are laid in the earth, which, in about fourteen days, as has been said, are hatched into maturity, the young ones come forth very small, but perfectly formed, and suffer no change during their existence : how long their life continues is not well known, but it certainly holds for more than two or three seasons. During the winter, they bury themselves deeper in the earth, and seem, in some measure, to share the general torpidity of the insect tribe. In spring, they revive with the rest of nature, and on those occasions, a moist or dewy evening brings them forth from their retreats, for the universal purpose of continuing their kind. They chiefly live in a light, rich, and fertile soil, moistened by dews or accidental showers, but avoid those places where the water is apt to lie

on the surface of the earth, or where the clay is too stiff for their easy progression under ground.

Helpless as they are formed, yet they seem very vigilant in avoiding those animals that chiefly make them their prey; in particular the mole, who feeds entirely upon them beneath the surface, and who seldom ventures, from the dimness of its sight, into the open air; him they avoid, by darting up from the earth, the instant they feel the ground move; and fishermen, who are well acquainted with this, take them in what numbers they choose, by stirring the earth where they expect to find them. They are also driven from their retreats under ground, by pouring bitter or acrid water thereon, such as that water in which green walnuts have been steeped, or a lye made of pot-ashes.

Such is the general outline of the history of these reptiles, which, as it should seem, degrades them no way beneath the rank of other animals of the insect creation; but we now come to a part of their history, which proves the imperfection of their organs, from the easiness with which these little machines may be damaged and repaired again. It is well known in mechanics, that the finest and most complicated instruments are the most easily put out of order, and the most difficultly set right; the same also obtains in the animal machine. Man, the most complicated machine of all others, whose nerves are more numerous, and powers of action more various, is most easily destroyed: he is seen to die under wounds which a quadruped or a bird could easily survive; and as we descend gradually to the lower ranks, the ruder the composition, the more difficult it is to disarrange it. Some animals live without their limbs, and often are seen to reproduce them; some are seen to live without their brain for many weeks together; caterpillars continue to increase and grow large, though all their nobler organs are entirely destroyed within; some animals continue to exist, though cut in two, their nobler parts preserving life, while the others perish that were cut away; but the earth-worm, and all the zoophyte tribe, continue to live in separate

parts, and one animal, by the means of cutting, is divided into two distinct existences, sometimes into a thousand.

There is no phænomenon in all natural history more astonishing than this, that man, at pleasure, should have a kind of creative power, and out of one life make two, each completely formed, with all its apparatus and functions, each with its perceptions, and powers of motion and self-preservation, each as complete in all respects as that from which it derived its existence, and equally enjoying the humble gratifications of its nature.

When des Cartes first started the opinion, that brutes were machines, the discovery of this surprizing propagation was unknown, which might, in some measure, have strengthened his fanciful theory. What is life, in brutes, he might have said, or where does it reside? In some we find it so diffused, that every part seems to maintain a vivacious principle, and the same animal appears possessed of a thousand distinct irrational souls at the same time. But let us not, he would say, give so noble a name to such contemptible powers, but rank the vivifying principle in these with the sap that rises in vegetables, or the moisture that contracts a cord, or the heat that puts water into motion! Nothing, in fact, deserves the name of soul, but that which reasons, that which understands, and by knowing God, receives the mark of its currency, and is minted with the impression of its great Creator.

Such might have been the speculations of this philosopher; however, to leave theory, it will be sufficient to say that we owe the first discovery of this power of reproduction in animals to mr. Trembley, who first observed it in the polypus, and after him, Spalanzani and others found it taking place in the earth-worm, the sea-worm, and several other ill-formed animals of a like kind, which were susceptible of this new mode of propagation. This last philosopher has tried several experiments upon the earth-worm, many of which succeeded according to his expectation; every earth-worm, however, did not retain the vivacious principle with the same obstinacy.

some, when cut in two, were entirely destroyed ; others survived only in the nobler part ; and while the head was living the tail entirely perished, and a new one was seen to burgeon from the extremity. But what was most surprizing of all, in some, particularly in the small red-headed earth-worm, both extremities survived the operation ; the head produced a tail with the anus, the intestines, the anular muscles, and the prickly beards ; the tail part, on the other hand, was seen to shoot forth the nobler organs, and in less than the space of three months, sent forth a head, heart, with all the apparatus and instruments of generation. This part, as may be easily supposed, was produced much more slowly than the former, a new head taking above three or four months for its completion, a new tail being shot forth in less than as many weeks. Thus, two animals, by dissection, were made out of one, each with their separate appetites, each endued with life and motion, and seemingly as perfect as that single animal from whence they derived their origin.

What was performed upon the earth-worm, was found to obtain also in many other of the vermicular species. The sea-worm, the white water-worm, and many of those little worms with feelers, found at the bottom of dirty ditches ; in all these the nobler organs are of such little use, that if taken away, the animal does not seem to feel the want of them ; it lives in all its parts, and in every part, and by a strange paradox in nature, the most useless and contemptible life is of all others the most difficult to destroy.

C H A P. III.

Of the Star-fish.

THE next order of zoophytes is that of the star-fish, a numerous tribe, shapeless and deformed, assuming at different times different appearances. The same animal that now appears round like a ball, shortly after flattens as thin as a plate. All of this kind are formed of a semi-transparent gelatinous substance, covered with a thin membrane, and to an inattentive spectator, often appear like a lump of inanimate jelly, floating at random upon the surface of the sea, or thrown by chance on shore at the departure of the tide. But upon a more minute inspection, they will be found possessed of life and motion; they will be found to shoot forth their arms in every direction, in order to seize upon such insects as are near, and to devour them with great rapacity. Worms, the spawn of fish, and even muscles themselves, with their hard resisting shell, have been found in the stomachs of these voracious animals; and what is very extraordinary, though the substance of their own bodies be almost as soft as water, yet they are no way injured by swallowing these shells, which are almost of a stony hardness. They increase in size as all other animals do. In summer, when the water of the sea is warmed by the heat of the sun, they float upon the surface, and in the dark they send forth a kind of shining light resembling that of phosphorus. Some have given these animals the name of sea-nettles, because they burn the hands of those that touch them, as nettles are found to do. They are often seen fastened to the rocks, and to the largest sea-shells, as if to derive their nourishment from them. If they be taken and put into spirit of wine, they will continue for many years entire, but if they be left to the influence of the air, they are, in less than four and twenty hours, melted down into limpid and offensive water.

Coral plants.



318.



308.

Sea Nettle

Star Fish

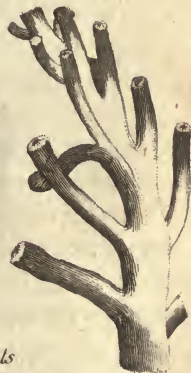


309.



318.

Coral plants





In all of this species, none are found to possess a vent for their excrements, but the same passage by which they devour their food, serves for the ejection of their fæces. These animals, as was said, take such a variety of figures, that it is impossible to describe them under one determinate shape; but in general, their bodies resemble a truncated cone, whose base is applied to the rock to which they are found usually attached. Though generally transparent, yet they are found of different colours, some inclining to green, some to red, some to white, and some to brown. In some, their colours appear diffused over the whole surface, in some, they are often streaked, and in others often spotted. They are possessed of a very slow progressive motion, and in fine weather, they are continually seen stretching out and fishing for their prey. Many of them are possessed of a number of long slender filaments, in which they entangle any small animals they happen to approach, and thus draw them into their enormous stomachs, which fill the whole cavity of their bodies. The harder shells continue for some weeks indigested, but at length, they undergo a kind of maceration in the stomach, and become a part of the substance of the animal itself. The indigestible parts are returned by the same aperture by which they were swallowed, and then the star-fish begins to fish for more. These also may be cut in pieces, and every part will survive the operation; each becoming a perfect animal, endued with its natural rapacity. Of this tribe, the number is various, and the description of each would be tedious and uninteresting; the manners and nature of all are nearly as described; but I will just make mention of one creature, which, though not properly belonging to this class, yet is so nearly related, that the passing it in silence would be an unpardonable omission.

Of all other animals, the cuttle-fish, though in some respect superior to this tribe, possesses qualities the most extraordinary. It is about two feet long, covered with a very thin skin, and its flesh composed of a gelatinous substance, which however within-side is strengthened by a strong bone, of which such great use is made by the goldsmiths. It is possessed of eight arms,

which it extends, and which are probably of service to it in fishing for its prey ; while in life, it is capable of lengthening or contracting these at pleasure ; but when dead, they contract and lose their rigidity. They feed upon small fish, which they seize with their arms ; and they are bred from eggs, which are laid upon the weeds along the sea-shore.

The cuttle-fish is found along many of the coasts of Europe, but are not easily caught, from a contrivance with which they are furnished by nature ; this is a black substance, of the colour of ink, which is contained in a bladder generally on the left side of the belly, and which is ejected in the manner of an excrement from the anus. Whenever therefore this fish is pursued, and when it finds a difficulty of escaping, it spurts forth a great quantity of this black liquor, by which the waters are totally darkened, and then it escapes, by lying close at the bottom. In this manner the creature finds its safety, and men find ample cause for admiration, from the great variety of stratagems with which creatures are endued for their peculiar preservation.

C H A P. IV.

Of the Polypus.

THOSE animals which we have described in the last chapter are variously denominated. They have been called the star-fish, sea-nettles, and sea-polipy. This last name has been peculiarly ascribed to them by the ancients, because of the number of feelers or feet of which they are all possessed, and with which they have a slow progressive motion ; but the moderns have given the name of polypus to a reptile that lives in fresh water, by no means so large or observable. These are found at the bottom of wet ditches, or attached to the under surface of the broad-leaved plants that grow and swim

on the waters. The same difference holds between these and the sea-water polypus, as between all the productions of the sea, and of the land and the ocean. The marine vegetables and animals grow to a monstrous size. The eel, the pike, or the bream of fresh-waters, is but small; but in the sea, they grow to an enormous magnitude. The herbs of the field are at most but a few feet high; those of the sea often shoot forth a stalk of a hundred. It is so between the polipy of both elements. Those of the sea are found two feet in length to three or four, and Pliny has even described one, the arms of which were no less than thirty feet long. Those in fresh waters, however, are comparatively minute; at their utmost size, seldom above three parts of an inch long, and when gathered up into their usual form, not above a third even of those dimensions.

It was upon these minute animals, that the power of dissection was first tried in multiplying their numbers. They had been long considered as little worthy the attention of observers, and were consigned to that neglect in which thousands of minute species of insects remain to this very day. It is true, indeed, that Reaumur observed, classed, and named them. By contemplating their motions, he was enabled distinctly to pronounce on their being of the animal, and not of the vegetable kingdom; and he called them polipy, from their great resemblance to those larger ones that were found in the ocean. Still, however, their properties were neglected, and their history unknown.

Mr. Trembley was the person to whom we owe the first discovery of the amazing properties and powers of this little vivacious creature: he divided this class of animals into four different kinds; into those inclining to green, those of a brownish cast, those of flesh-colour, those which he calls the polype de panache. The differences of structure in these, as also of colour, are observable enough; but the manner of their subsisting, of seizing their prey, and of their propagation, is pretty nearly the same in all.

Whoever has looked with care into the bottom of a wet

ditch, when the water is stagnant, and the sun has been powerful, may remember to have seen many little transparent lumps of jelly, about the size of a pea, flattened on one side; such also as have examined the under side of the broad-leaved weeds that grow on the surface of the water, must have observed them studded with a number of these little jelly-like substances, which were probably then disregarded, because their nature and history was unknown. These little substances, however, were no other than living polipy gathered up into a quiescent state, and seemingly inanimate, because either disturbed, or not excited by the calls of appetite to action. When they are seen exerting themselves, they put on a very different appearance from that when at rest; to conceive a just idea of their figure, we may suppose the finger of a glove cut off at the bottom; we may suppose also several threads or horns planted round the edge like a fringe. The hollow of this finger will give us an idea of the stomach of the animal, the threads issuing forth from the edges may be considered as the arms or feelers, with which it hunts for its prey. The animal, at its greatest extent, is seldom seen above an inch and a half long, but it is much shorter when it is contracted and at rest; it is furnished neither with muscles nor rings, and its manner of lengthening or contracting itself, more resembles that of the snail, than worms, or any other insect. The polypus contracts itself more or less, in proportion as it is touched, or as the water is agitated in which they are seen. Warmth animates them, and cold benumbs them; but it requires a degree of cold approaching congelation before they are reduced to perfect inactivity; those of an inch have generally their arms double, often thrice as long as their bodies. The arms, where the animal is not disturbed, and the season not unfavourable, are thrown about in various directions, in order to seize and entangle its little prey; sometimes three or four of the arms are thus employed, while the rest are contracted like the horns of a snail, within the animal's body. It seems capable of giving what length it pleases to these arms; it contracts and extends them at plea-

ture, and stretches them only in proportion to the remoteness of the object it would seize.

These animals have a progressive motion, which is performed by that power they have of lengthening and contracting themselves at pleasure; they go from one part of the bottom to another; they mount along the margin of the water, and climb up the side of aquatic plants. They are often seen to come to the surface of the water, where they suspend themselves by their lower end. As they advance but very slowly, they employ a great deal of time in every action, and bind themselves very strongly to whatever body they chance to move upon as they proceed; their adhesion is voluntary, and is probably performed in the manner of a cupping-glass applied to the body.

All animals of this kind have a remarkable attachment to turn towards the light, and this naturally might induce an enquirer to look for their eyes; but however carefully this search has been pursued, and however excellent the microscope with which every part was examined, yet nothing of the appearance of this organ was found over the whole body; and it is most probable that, like several other insects which hunt their prey by their feeling, these creatures are unfurnished with advantages which would be totally useless for their support.

In the centre of the arms, as we said before, the mouth is placed, which the animal can open and shut at pleasure, and this serves at once as a passage for food, and an opening for it after digestion. The inward part of the animal's body seems to be one great stomach, which is open at both ends; but the purposes which the opening at the bottom serves are hitherto unknown, but certainly not for excluding their excrements, for those are ejected at the aperture by which they are taken in. If the surface of the body of this little creature be examined with a microscope, it will be found studded with a number of warts, as also the arms, especially when they are contracted; and these tubercles, as we shall presently see answer a very important purpose.

If we examine their way of living, we shall find these insects chiefly subsisting upon others, much less than themselves, particularly a kind of millepedes that live in the water, and a very small red worm, which they seize with great avidity. In short, no insect whatsoever, less than themselves, seems to come amiss to them; their arms, as was observed before, serve them as a net would a fisherman, or perhaps, more exactly speaking, as a lime-twigg does a fowler. When their prey is perceived, which the animal effects by its feeling, it is sufficient to touch the object it would seize upon, and it is fastened, without a power of escaping. The instant one of this insect's long arms is laid upon a millepede, the little insect sticks without a possibility of retreating. The greater the distance at which it is touched, the greater is the ease with which the polypus brings the prey to its mouth. If the little object be near, though irretrievably caught, it is not without great difficulty that it can be brought to the mouth and swallowed. When the polypus is unsupplied with prey, it testifies its hunger by opening its mouth; the aperture, however, is so small, that it cannot be easily perceived; but when, with any of its long arms, it has seized upon its prey, it then opens the mouth distinctly enough, and this opening is always in proportion to the size of the animal which it would swallow; the lips dilate insensibly by small degrees, and adjust themselves precisely to the figure of their prey. Mr. Trembley, who took a pleasure in feeding this useless brood, found that they could devour aliments of every kind, fish and flesh as well as insects; but he owns they did not thrive so well upon beef and veal, as upon the little worms of their own providing. When he gave one of these famished reptiles any substance which was improper to serve for aliment, at first it seized the prey with avidity, but after keeping it some time entangled near the mouth, dropt it again with distinguishing nicety.

When several polipy happen to fall upon the same worm, they dispute their common prey with each other. Two of them are often seen seizing the same worm at different ends, and dragging it at opposite directions with great force. It often

happens that while one is swallowing its respective end, the other is also employed in the same manner, and thus they continue swallowing each his part, until their mouths meet together; they then rest, each for some time in this situation, till the worm breaks between them, and each goes off with his share; but it often happens, that a seemingly more dangerous combat ensues, when the mouths of both are thus joined upon one common prey together: the largest polypus then gapes and swallows his antagonist; but what is very wonderful, the animal thus swallowed seems to be rather a gainer by the misfortune. After it has lain in the conqueror's body for about an hour, it issues unhurt, and often in possession of the prey which had been the original cause of contention; how happy would it be for men, if they had as little to fear from each other!

These reptiles continue eating the whole year, except when the cold approaches to congelation; and then, like most others of the insect tribe, they feel the general torpor of nature, and all their faculties are for two or three months suspended; but if they abstain at one time, they are equally voracious at another, and like snakes, ants, and other animals that are torpid in winter, the meal of one day suffices them for several months together. In general, however, they devour more largely in proportion to their size, and their growth is quick exactly as they are fed; such as are the best supplied, soonest acquire their largest size, but they diminish also in their growth with the same facility, if their food be taken away.

Such are the more obvious properties of these little animals, but the most wonderful still remain behind: their manner of propagation, or rather multiplication, has, for some years, been the astonishment of all the learned of Europe. They are produced in as great a variety of manners as every species of vegetable. Some polipy are propagated from eggs, as plants are from their seed; some are produced by buds issuing from their bodies, as plants are produced by inoculation, while all may be multiplied by cuttings, and this to a degree of minuteness that exceeds even philosophical perseverance.

With respect to such of this kind as are hatched from the egg, little curious can be added, as it is a method of propagation so common to all the tribes of insect nature ; but with regard to such as are produced like buds from their parent stem, or like cuttings from an original root, their history requires a more detailed explanation. If a polypus be carefully observed in summer, when these animals are chiefly active, and more particularly prepared for propagation, it will be found to burgeon forth from different parts of its body several tubercles or little knobs, which grow larger and larger every day ; after two or three days inspection, what at first appeared but a small excrescence, takes the figure of a small animal, entirely resembling its parent, furnished with feelers, a mouth, and all the apparatus for seizing and digesting its prey. This little creature every day becomes larger, like the parent, to which it continues attached ; it spreads its arms to seize upon whatever insect is proper for aliment, and devours it for its own particular benefit ; thus it is possessed of two sources of nourishment, that which it receives from the parent by the tail, and that which it receives from its own industry by the mouth. The food which these animals receive often tinctures the whole body, and upon this occasion the parent is often seen communicating a part of its own fluids to that of its progeny that grows upon it ; while, on the contrary, it never receives any tincture, from any substance that is caught and swallowed by its young. If the parent swallows a red worm, which gives a tincture to all its fluids, the young one partakes of the parental colour ; but if the latter should seize upon the same prey, the parent polypus is no way benefited by the capture, but all the advantage remains with the young one.

But we are not to suppose that the parent is capable of producing only one at a time : several young ones are thus seen at once, of different sizes, growing from its body, some just budding forth, others acquiring their perfect form, and others come to a sufficient maturity, and just ready to drop from the original stem to which they had been attached for several days. But what is more extraordinary still, those young ones them-

selves that continue attached to their parent, are seen to burgeon, and propagate their own young ones also, each holding the same dependence upon its respective parent, and possessed of the same advantages that have been already described in the first connexion. Thus we see a surprizing chain of existence continued, and numbers of animals naturally produced without any union of the sexes, or other previous disposition of nature.

This seems to be the most natural way by which these insects are multiplied; their production from the egg being not so common; and though some of this kind are found with a little bladder attached to their bodies, which is supposed to be filled with eggs, which afterwards come to maturity, yet the artificial method of propagating these animals, is much more expeditious and equally certain: It is indifferent whether one of them be cut into ten, or ten hundred parts, each becomes as perfect an animal as that which was originally divided; but it must be observed, that the smaller the part which is thus separated from the rest, the longer it will be in coming to maturity, or in assuming its perfect form. It would be endless to recount the many experiments that have been tried upon this philosophical prodigy; the animal has been twisted, and turned into all manner of shapes; it has been turned inside out, it has been cut in every division, yet still it continued to move; its parts adapted themselves again to each other, and in a short time, it became as voracious and industrious as before.

Besides these kinds mentioned by Mr. Trembley, there are various others which have been lately discovered by the vigilance of succeeding observers, and some of these so strongly resemble a flowering vegetable in their forms, that they have been mistaken by many naturalists for such. Mr. Hughes, the author of the natural history of Barbadoes, has described a species of this animal, but has mistaken its nature, and called it a sensitive flowering plant; he observed it to take refuge in the holes of rocks, and when undisturbed, to spread forth a number of ramifications, each terminated by a flowery petal which shrunk at the approach of the hand, and withdrew into

the hole from whence before it had been seen to issue. This plant however was no other than an animal of the polypus kind, which is not only to be found in Barbadoes, but also on many parts of the coast of Cornwall, and along the shores of the Continent.

C H A P. V.

Of the Lythophytes and Sponges.

IT is very probable that the animals we see and are acquainted with, bear no manner of proportion to those that are concealed from us. Although every leaf and vegetable swarms with animals upon land, yet at sea, they are still more abundant; for the greatest part of what would seem vegetables growing there, are in fact nothing but the artificial formation of insects, palaces which they have built for their own habitation.

If we examine the bottom of the sea along some shores, and particularly at the mouths of several rivers, we shall find it has the appearance of a forest of trees under water, millions of plants growing in various directions, with their branches entangled in each other, and sometimes standing so thick as to obstruct navigation. The shores of the Persian gulph, the whole extent of the Red-sea, and the western coasts of America, are so choaked up in many places with these coralline substances, that though ships force a passage through them, boats and swimmers find it impossible to make their way. These aquatic groves are formed of different substances, and assume various appearances. The coral-plants, as they are called, sometimes shoot out like trees without leaves in winter; they often spread out a broad surface like a fan, and not uncommonly a large bundling head, like a faggot; sometimes they are found to resemble a plant with leaves and flowers; and often the

entlers of a stag, with great exactness and regularity. In other parts of the sea are seen sponges of various magnitude, and extraordinary appearances, assuming a variety of phantastic forms like large mushrooms, mitres, fonts and flower-pots. To an attentive spectator these various productions seem entirely of the vegetable kind; they seem to have their leaves and their flowers, and have been experimentally known to shoot out branches in the compass of a year. Philosophers, therefore, till of late, thought themselves pretty secure in ascribing these productions to the vegetable kingdom; and count Marfigli, who has written very laboriously and learnedly upon the subject of corals and sponges, has not hesitated to declare his opinion, that they were plants of the aquatic kind, furnished with flowers and seed, and endued with a vegetation entirely resembling that which is found upon land. This opinion, however, some time after, began to be shaken, by Rumphius and Jussieu, and at last by the ingenious mr. Ellis, who by a more sagacious and diligent enquiry into nature, put it past doubt, that corals and sponges were entirely the work of animals, and that like the honey-comb, which was formed by the bee, the coral was the work of an infinite number of reptiles of the polypus kind, whose united labours were thus capable of filling whole tracts of the ocean with those embarrassing tokens of their industry.

If in our researches after the nature of these plants, we should be induced to break off a branch of the coralline substance, and observe it carefully, we shall perceive its whole surface, which is very rugged and irregular, covered with a mucous fluid, and almost in every part studded with little jelly-like drops, which, when closely examined, will be found to be no other than reptiles of the polypus kind. These have their motions, their arms, their appetites, exactly resembling those described in the last chapter, but they soon expire when taken out of the sea, and our curiosity is at once stopped in its career, by the animals ceasing to give any marks of their industry; recourse therefore has been had to other expedients, in order

to determine the nature of the inhabitant, as well as the habitation.

If a coraline plant be strictly observed, while still growing in the sea, and the animals upon its surface be not disturbed, either by the agitation of the waters, or the touch of the observer, the little polipy will then be seen in infinite numbers, each issuing from its cell, and in some kinds, the head covered with a little shell, resembling an umbrella, the arms spread abroad, in order to seize its prey, while the hinder part still remains attached to its habitation, from whence it never wholly removes. By this time it is perceived that the number of inhabitants is infinitely greater than was at first suspected; that they are all assiduously employed in the same pursuits, and that they issue from their respective cells, and retire into them at pleasure. Still, however, there are no proofs that those large branches which they inhabit are entirely the construction of such feeble and minute animals. But chemistry will be found to lend a clue to extricate us from our doubts in this particular. Like the shells which are formed by snails, muscles and oysters, these coraline substances effervesce with acids, and may therefore well be supposed to partake of the same animal nature. But Mr. Ellis went still farther, and examined their operations, just as they were beginning. Observing an oyster-bed which had been for some time neglected, he there perceived the first rudiments of a coraline plantation, and tufts of various kinds shooting from different parts of this favourable soil. It was upon these he tried his principal experiment. He took out the oysters which were thus furnished with corallines, and placed them in a large wooden vessel, covering them with sea-water. In about an hour, he perceived the animals, which before had been contracted by handling, and had shown no signs of life, expanding themselves in every direction, and appearing employed in their own natural manner. Perceiving them therefore in this state, his next aim was to preserve them thus expanded, so as to be permanent objects of curiosity. For this purpose, he poured, by slow degrees, an equal quantity of boiling water into the vessel of sea-water in which they

were immersed. He then separated each polypus with pincers from its shell, and plunged each separately into small crystal vases, filled with spirit of wine mixed with water. By this means, the animal was preserved entire, without having time to contract itself, and he thus perceived a variety of kinds, almost equal to that variety of productions, which these little animals are seen to form. He has been thus able to perceive and describe fifty different kinds, each of which is seen to possess its own peculiar mode of construction, and to form a coralline that none of the rest can imitate. It is true, indeed, that on every coralline substance there are a number of polipy found, no way resembling those which are the erectors of the building; these may be called a vagabond race of reptiles, that are only intruders upon the labours of others, and that take possession of habitations, which they have neither art nor power to build for themselves. But in general, the same difference that subsists between the honey-comb of the bee, and the paper-like cells of the wasp, subsists between the different habitations of the coral-making polipy.

With regard to the various forms of these substances, they have obtained different names from the nature of the animal that produced them, or the likeness they bear to some well-known object, such as coralines, fungimadrepores, sponges, astroites, and keratophytes. Though these differ extremely in their outward appearances, yet they all are formed in the same manner, by reptiles of various kinds and nature. When examined chemically, they all discover the marks of animal formation; the corals, as was said, dissolve in acids, the sponges burn with an odour strongly resembling that of burnt horn. We are left somewhat at a loss with regard to the precise manner in which this multitude of cells, which at last assume the appearance of a plant or flower, are formed. If we may be led in this subject by analogy, it is most probable, that the substance of coral is produced in the same manner that the shell of the snail grows round it; these little reptiles are each possessed of a slimy matter, which covers its body, and this har-

dening, as in the snail, becomes an habitation exactly fitted to the body of the animal that is to reside in it; several of these habitations being joined together, form at length a considerable mass, and as most animals are productive, in proportion to their minuteness, so these multiplying in a surprizing degree, at length form those extensive forests that cover the bottom of the deep.

Thus all nature seems replete with life; almost every plant on land has its surface covered with millions of these minute creatures, of whose existence we are certain, but of whose uses we are entirely ignorant; while numbers of what seem plants at sea are not only the receptacles of insects, but also entirely of insect formation. This might have led some late philosophers into an opinion, that all nature was animated, that every, even the most inert mass of matter, was endued with life and sensation, but wanted organs to make those sensations perceptible to the observer: Those opinions, taken up at random, are difficultly maintained, and as difficultly refuted; like combatants that meet in the dark, each party may deal a thousand blows without ever reaching the adversary. Those perhaps are wiser who view nature as she offers; who, without searching too deeply into the recesses in which she ultimately hides, are contented to take her as she presents herself, and storing their minds with effects, rather than with causes, instead of the embarrassment of systems, about which few agree, are contented with the history of appearances, concerning which, all mankind have but one opinion.

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- Mold*, black, or garden-earth, the first layer on the surface of the globe—is formed from animal and vegetable bodies decayed—soil fertile, in proportion to the quantity that putrified mold bears to the gravelly mixture, i. 40, 41.
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native of Canada—creeps into holes, where others, seemingly less, cannot follow—the female has two distinct apertures, one for the urine, the other for propagation—this animal in some measure resembles the beaver—its manner of life during winter, in houses covered under a depth of eight or ten feet of snow, 279—savages of Canada cannot abide its scent, called it stinkard—its skin very valuable, 280.

Onza, or ounce, of the panther-kind, ii. 147—the onza of Linnaeus, 148.

Ophidium, the gilt-head, by sailors called the dolphin, its description, iii. 376.

Opposum, an animal in North and South America, of the size of a small cat, and of the monkey kind, 374, 375—its description—the female's belly found double—when pursued, she instantly takes her young into a false belly nature has given her, and carries them off, or dies in the endeavour, i. 334, 335—a minute description of it—the young, when first produced are very small, and immediately on quitting the real womb, they creep into the false one, but the time of continuance is uncertain—Ulloa has found five young hidden in the belly of the dam, alive and clinging to the teat, three days after she was dead, ii. 375, 376—chiefly subsists upon birds, and hides among the leaves of trees, to seize them by surprise—cannot run with any swiftness, but climbs trees with great ease and expedition—it often hangs by the tail, and for hours together, with the head downwards, keeps watching for its prey—by means of its tail, flings itself from one tree to another, hunts insects, and escapes its pursuers—eats vegetables as well as animal substance—is easily tamed, but a disagreeable domestic, from its stupidity, figure, and scent, which, though fragrant in small quantities, is ungrateful when copious, 376, 377—during its gestation, the bag in which the young are concealed may be opened and examined without inconvenience; the young may be counted and handled; they keep fixed to the teat, and cling as firm as if they made a part of the body of the mother, 376.

Orange-flowers, particularly grateful to the taste and smelling of the elephant, iii. 383.

Orb, description of the sea-orb, also called the sea-porcupine—is absolutely poisonous, if eaten, iii. 369.

Ore of tin is heavier than that of other metals, i. 53—the basest ores in general the most beautiful to the eye, ib.

Organs of digestion, in a manner, reversed in birds, iii. 11.

Organs of generation in fishes, iii. 309.

Orifices, or different verges of snails, iv. 21.

Original, French name of the American elk, ii. 84.

Orkney Islands, on their shores, the sea, when agitated by storm, rises two hundred feet perpendicular, i. 167—a law in those islands entitles any person that kills an eagle to a hen out of every house in the parish in which it is killed, iii. 52.

Oroonoko, a river in South America, its source, and length, i. 135.

Ortolan, a bird of the sparrow-kind, iii. 167.

Osprey, its flesh is liked by many, and, when young, an excellent food according to Belonius, iii. 48—it chiefly lives upon fish, 54—its distinctive marks, 55.

Ostiac Tartars, a race that have travelled down from the North, i. 367, 368.

Ostracion, a fish of the cartilaginous kind, is poisonous, iii. 369.

Ostrich, the greatest of birds, makes near approaches to the quadruped class, iii. 29—its description—appears as tall as a man on horse-back—brought into England above seven feet high—surprising conformation of its internal parts, 29, 30, 31—a native only of the torrid regions of Africa—its flesh proscribed in scripture as unfit to be eaten—not known to breed elsewhere than where first produced—places they inhabit—the Arabians say it never drinks—will devour leather, glass, hair, iron, stones, or any thing given, 32—in native deserts, lead an inoffensive social life—Thevenot affirms the male keeps to the female with connubial fidelity, though much inclined to venery—some of their eggs weigh fifteen pounds—season for laying depends on the climate where the animal is bred—these birds very prolific, and lay from forty to fifty eggs at one clutch, 33—none has a stronger affection for her young, nor watches her eggs with greater assiduity, sit on them, like other birds, male and female by turns, assiduous in supplying the young with grass, and careful to defend them, encountering every danger boldly—way of taking them among the ancients—the plumes used in their helmets—the ladies of the East use them as ornaments in their dress—plumes used in Europe to decorate our hearsees and hats—feathers plucked from the animal while alive more valued than those taken when dead—some savage nations of Africa hunt them for their flesh, 34—*Eliliogabalus* had the brains of six hundred dressed in one dish—a single egg sufficient entertainment for eight men—eggs well tasted, and extremely nourishing—*Apicius* gives a receipt of sauce for the ostrich—of all chafes, that of the ostrich, though most laborious, the most entertaining, 35—manner in which the Arabians hunt them, i. 441. and iii. 35—use they make of its skin—method of hunting of the *struthophagi*—its blood mixed with the fat; a great dainty with the Arabians—inhabitants of *Dara* and *Lybia* breed flocks of them—tamed with little trouble—prized for more than feathers in this domestic state—often ridden upon and used as horses—*Moore* assures he saw a man at *Joar* travelling upon an ostrich; and *Adanson* asserts he had two young ostriches, the strongest of which ran swifter than the best English racer. with two negroes on his back, 36—an Arabian horse of the first speed scarcely outruns them, i. 441—of all animals using legs in running, these by far the swiftest, iii. 35—parts of it convertible to medicinal purposes, 36—eggs worst of all to be eaten according to *Galen*—the American ostrich, ib.

Otter, of roses, a modern perfume, valued for its vegetable fragrance, ii. 228.

Otter, the link, between land and amphibious animals, resembles terrestrial in make, and aquatic in living—swims faster than it runs—is brown and like an over-grown weasel—its description, ii. 318, 319—voracious animal, found near lakes—not fond of fishing in running water, and why—when in rivers always swims against the stream, to meet rather than pursue the fish it preys upon—in lakes, destroys more than it devours, and spoils a pond in a few nights—tears to pieces the nets of the fishers—two different methods of fishing practised by it, 320—infests the edges of lakes with the dead fish it leaves—often distressed for provision in winter when lakes are frozen, and then obliged to live upon grass, weeds, and bark of trees—its retreat the hollow of a bank

made by the water—there it forms a gallery several yards along the water—how it evades the fowler—time of coupling—description of its habitation, 321—way of training it up to hunt fish, and, at the word of command, drive them up to the corner of a pond, seize the largest and bring it in its mouth to its master—to take an old otter alive not easy—few dogs dare to encounter it—marks of its residence—bites with great fierceness, and never lets go its hold—brings forth its young under hollow banks upon beds of rushes, flags, or weeds—manner of taking the young alive—how fed when taken, 322, 323—continues long without food—couples about midsummer in Europe, and brings forth at nine weeks end, three or four at a time, 321—some dogs trained up to discover its retreat, 323—otters met with in most parts of the world—in North America and Carolina found white, inclining to yellow—description of the Brazilian otter, 324.

Ovale, foramen, in the embryo, a passage for the blood from the right cavity of the heart to the left and the great artery, i. 268—it closes when the lungs begin their function, 269—it never closes in the seal's heart, ii. 332.

Ovaria, two glandular bodies near the womb, resembling the cluster of small eggs found in fowls, i. 251, 252.

Ouarine, species of monkeys so called by mr. Buffon, remarkable for the loudness of their voice, and the use to which they apply it, ii. 364, 365.

Oviparous animals, distinguished from the viviparous, the two classes for generation; all other modes held imaginary and erroneous, i. 254, 255.

Ouran-outang, the wild man of the wood, an animal nearly approaching the human race, is the foremost of the ape-kind—this name given to various animals walking upright, but of different countries, proportions and powers—the troglodyte of Bontius, the drill of Purchas, and the pigmy of Tyfon have received this general name, ii. 343—its description in a comparative view with man, 344, 345—gigantic races of it described by travellers truly formidable—many are taller than man, active, strong, intrepid, cunning, lascivious, and cruel—countries where found—in Borneo the quality course him as we do the stag, and this hunting is a favourite amusement of the king—runs with great celerity—its description—Battel called him pongo; assures us that in all he resembles man, but is larger to a gigantic state—a native of the tropical climates—he lives upon fruits, and is not carnivorous—goes in companies; and this troop meeting one of the human species without succour, shew him no mercy—they jointly attack the elephant, beat him with clubs, and force him to leave that part of the forest they claim as their own—is so strong, that ten men are not a match for it—none of the kind taken but very young—one of them dying, the rest cover the body with leaves and branches—a negro boy taken by one of these, and carried into the woods, continued there a whole year without any injury—they often attempt the female negroes going into the woods, and keep them against their wills for their company, feeding them plentifully all the time—a traveller assures, that he knew a woman of Loango that lived among them for three years—they build sheds, and use clubs for their defence, 349, 350—sometimes walk upright, and sometimes upon all-fours, when phantastically disposed—though it resembles man in form,

and imitates his actions, it is inferior in sagacity even to the elephant or the beaver, 351—two of these creatures brought to Europe, discovered an astonishing power of imitation, sat at table like men, ate of every thing without distinction, made use of knife, fork, and spoon, drank wine and other liquors—the male of these two creatures being sea-sick, was twice bled in the arm; and afterwards when out of order, he shewed his arm as desirous of relief by bleeding—another was surprizingly well behaved, drank wine moderately, and gladly left it for milk or other sweet liquors; it had a defluxion upon the breast, which encreasing, caused its death in the space of one year from its arrival, 346, 347.

Ounce, or *onza*, ii. 147—distinguished from the panther, the ounce of Linnæus, 148—remarkable for being easily tamed, and employed all over the East for the purposes of hunting, 51, 52, and does not pursue by the smell like the dog-kind, 151—the hyena attacks it, and seldom fails to conquer, 199—one at present in the tower of London, with which the keeper plays without the smallest apprehension—manner of hunting with it, 151.

Owl, common mark by which all birds of this kind are distinguished from others—general characteristics of birds of the owl-kind, iii. 76, 77—the skreech-owl, and its distinctive marks, 49—though dazzled by a bright day-light, they do not see best in the darkest nights, as imagined—seasons in which they see best—nights of moonlight the times of their successful plunder—seeing in the night or being dazzled by day, not alike in every species of this kind—instances in the white, or barn-owl, and in the brown-horn owl, 77—description of the great horned owl, 78—description of the common horned owl, 49, 78—names of several owls without horns—these horns nothing more than two or three feathers that stand upon each side of the head over the ear, 78—times of making their excursions—places where found in the day-time, 79—father Kircher having set the voices in birds to music, has given all the tones of the owl note, which make a most tremendous melody—sometimes bewildered, what they do in that distress—aversion of small birds to the owl—how they injure and torment him in the day-time—an owl appearing by day sets a whole grove into an uproar, 80—small birds sometimes hunt the owl until evening, when recovering sight, he makes the foremost pay dear for their sport, and does not always leave man an unconcerned spectator—sport of bird-catchers, by counterfeiting the cry of the owl—in what manner the great horned owl is used by falconers to lure the kite, when wanted for training the falcon—places where the great horned owl breeds—its nest, and number of eggs, 81—the lesser owl takes by force the nest of some other bird—number of eggs—the other owl breeds near the place where they chiefly prey—a single owl more serviceable than six cats, in ridding a barn of mice—an army of mice devoured at Hallontide by a number of strange painted owls—are shy of man, extremely untractable, and difficult to tame—the white owl in captivity refuses all nourishment, and dies of hunger—account of Mr. Buffon to this purpose, 82.

Ox, its eyes are brown, i. 289—on the fertile plains of India it grows to a size four times as large as the same kind bred in the Alps, 378, 432—one in England sixteen hands high; its growth depends on the richness of pasture, ii. 10.

Oxney, an island near Romney marsh, in what manner produced, i. 169.

Oysters bivalved shell-fish, are self-impregnated, iv. 30—the particulars in which they differ from the muscle—growing even amidst branches of the forest—have no other seeming food than the afflux of sea-water, 30, 31—they are deposited in beds where the tide comes in, at Colchester, and other places in the kingdom—these said to be better tasted—amazing size of oysters along the coast of Coramandel, 32—surprising manner in which monks manage an oyster, ii. 365—a horse known to be fond of oysters, i. 429—the pearl oyster has a large whitish shell, the internal coat of which is the mother of pearl, iv. 34.

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Paca, improperly called American rabbit, an animal of South-America—its cry and manner of eating—is most like the agouti, yet differs in several particulars—its description—places where generally found—its flesh considered as a delicacy, and eaten skin and all like a young pig—is seldom taken alive, defending itself to the last extremity—persecuted not only by man but by every beast and bird of prey, ii. 264—breeds in such numbers, the diminution is not perceptible, 269.

Pachomac deserts, where the formidable bird condor is chiefly seen, men seldom venture to travel, hissing serpents, and prowling panthers, being the scattered inhabitants, iii. 59.

Pacific-sea, the winds never change in it, i. 207, 208.

Paco, a kind of camel in South-America—its wool very valuable, ii. 415, 416.

Paddock-moon, the silence of frogs in dry weather may serve to explain an opinion, that there is a month in the year so called, in which they never croak, iv. 52.

Pain, nothing but repeated experience shews how seldom pain can be suffered to the ut most, i. 362.

Painters never fully imitate that bold relieve, which both eyes give to the object, i. 328.

Paleness often the effect of anger, and almost ever the attendant of fright and fear, i. 295.

Palm-tree, the elephant eats the shoots, leaves, and branches, to the stump ii. 383—its juice drank by the roussette, or the great bat of Madagascar, 316.

Pambamarca, mountain at Quinto, in Peru—a very uncommon meteor, seen upon it by Ulloa, i. 232.

Pangolin, vulgarly the scally lizard, is a native of the torrid climates of the ancient continent—of all animals, the best protected from external injury, ii. 302—its description—at the approach of an enemy, it rolls itself up like an hedge-hog, 303—the tyger, panther, and hyena, make vain attempts to force this animal, when it rolls itself up like the hedge-hog—its flesh considered by the negroes of Africa as a great delicacy—it has no teeth—lives entirely upon insects—there is not a more harmless, inoffensive creature than this, unmolested—cunning in hunting for its prey—chiefly keeps in the obscure parts of the forests—its tongue, when extended, is shot out to above a quarter of a yard beyond the tip of the nose—countries where found, 304, 305.

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- Panther* the foremost of the mischievous spotted kind, by many naturalists mistaken for the tiger, ii. 145—the panther of Senegal—the large panther—difference between these two—that of America, or jaguar, compared with the two former, 146, 147—sometimes employed in hunting—the gazelle, or leveret, are its prey—it sometimes attacks its employer, 151—it naturally hunts the sheep and the goat, i. 425—attends to the call of the jackall, ii. 196.
- Par*, a peasant, lived to a hundred and forty-four, without being abstemious, i. 358.
- Paradise-bird*, few have more deceived and puzzled the learned than this—it is an inhabitant of the Molucca islands—erroneous reports concerning this bird, and what has given rise to them—the native savages of those islands carefully cut off its legs before they bring it to market; and why, iii. 137—two kinds of the bird of paradise—their distinction from other birds—the description of this bird, 138—found in great numbers in the island of Aro, where the inhabitants call it God's bird—live in large flocks, and at night perch upon the same tree—are called by some, the swallows of Ternate, and, like them, have their stated times of return—their king distinguished from the rest by the lustre of his plumage, and the respect and veneration paid to him—killing the king, the best chance of getting the flock—the chief mark to know the king is by the ends of the feathers in the tail, having eyes like those of the peacock—a number of these birds taken, the method is to gut them, cut off their legs, dry the internal moisture with a hot iron, and fill the cavity with salt and spices, then sell them to the Europeans for a mere trifle—how this bird breeds, or what the number of its young, remains for discovery, 139—for beauty it exceeds all others of the pie-kind, 138.
- Parakeets*, a kind of parrot of a lesser size, iii. 145—of that kind in Brasil, Labat assures us, there are the most beautiful in plumage, and the most talkative birds in nature, 149, 150. See *Parrot*.
- Parana*, a river in South-America. wherewith at eight hundred leagues from its source, the Plata runs to its mouth, i. 135.
- Parafina*, name given by the Italians to a fishing line, not less than twenty miles long—baited with ten or twelve thousand hooks, and sunk to the bottom along the coast in the Mediterranean for that fishing called the *pieloga*, iii. 351.
- Parasite* plants, not able to support themselves, grow and fix upon some neighbouring tree, i. 248.
- Pard*, name given by Linnæus to the panther, ii. 145.
- Pardalis*, another name Gesner gives the panther, ii. 145.
- Parrot*, the middle or second size of the kind, described, iii. 145, 146—the ease with which this bird is taught to speak, and the number of words it is capable of repeating, are surprising—a grave writer affirms, that one of these was taught to repeat a whole sonnet from Petrarch—the author has seen one taught to pronounce the ninth commandment articulately, 143, 144—account of a parrot belonging to Henry VII. which fell into the Thames, crying, *A boat, twenty pounds for a boat*, 144—Linnæus makes its varieties amount to forty-seven; Brisson extends his catalogue to ninety-five, and the author thinks them numberless—assertion, that the natives of Brasil by art change the colour of a parrot's plumage—peculiarities observed in their conformation, common enough in Europe, will not however breed here—loses

spirits and appetite during the rigour of winter, 144, 145, 146—instances of sagacity and docility, particularly of the great parrot called aicurous—their habits—their nests, and the number of eggs—usual method of taking the young, 147, 148—always speak best, when not accustomed to harsh wild notes—what fruit or grain these birds feed upon, their flesh partakes of the flavor and taste—instances of it—seed of the cotton-tree intoxicates them, as wine does man—wine renders them more talkative and amusing, 149—in France very expert, but nothing to those of Brasil, which Clusius says, are most sensible and cunning, 147—natives of Brasil shoot them with heavy arrows, headed with cotton, which knock down the bird without killing it—those of the parakeet tribe are delicate eating, 149—of this kind in Brasil, Labat assures there are the most beautiful in plumage, and the most talkative possible, are restless and ever on the wing—their habits—their outcry when their companions fall—are very destructive on the coast of Guinea—more than a hundred different kinds counted on the coast of Africa, 149, 150—the white sort called lories, 145—countries where found—one, north of the Cape of Good Hope, takes its name from the multitude of parrots in its woods—an hundred kinds now known, not one of which naturally breeds in countries that acknowledged the Roman power—the green parakeet, with a red neck, was the first of the kind brought into Europe, and the only one known to the ancients from Alexander the Great to Nero—disorders peculiar to the parrot-kind—one well kept will live five or six and twenty years, 150, 151.

Parasley, pinks, and birch, hares are particularly fond of, ii. 237.

Partridges, in England, a favourite delicacy at the tables of the rich, whose desire of keeping them to themselves, has been gratified with laws for their preservation, no way harmonizing with the general spirit of English legislation, and why—there are two kinds, the grey and the red, iii. 111—the grey is most prolific, and always keep on the ground—the red less common, and perches upon trees—the partridge is found in every country, and climate—in Greenland, where it is brown in summer, becomes white in winter—those of Barakonda, are larger legged, swifter of foot, and reside in the highest rocks—partridges of all sorts agree in one character, being immoderately addicted to venery; often to an unnatural degree—the male pursues the hen to her nest, and breaks her eggs, rather than be disappointed—the young having kept in flocks during winter, break society in spring, when they begin to pair; and terrible combats ensue—their manners otherwise resemble those of poultry, but their cunning and instincts are superior—means the female uses to draw away any formidable animal that approaches her nest, 112—the covies are from ten to fifteen, and, unmolested, they live from fifteen to seventeen years—method of taking them in a net with a setting-dog the most pleasant, and most secure—they are never so tame as our domestic poultry, 113.

Passage (birds of) causes of their emigrations, iii. 19, 20—in one country are not so in others—many of those kinds which at certain seasons leave England, are seen in other climates, never to depart, it is also frequent, that some birds with us faithful residents, in other kingdoms put on the nature of birds of passage—instances of both, 169.

Passions, most of the furious sort characterised from the elevation and depression of the eye-brows, i. 290—freedom from passions not only adds to the happiness of the mind, but preserves the beauty of the face, 356.

Pastures, those of Great-Britain excellently adapted to quadrupeds of the cow-kind, ii. 8.

Patas, by some called the red African monkey—its description, ii. 368.

St. Paul, in Lower Brittany, in that neighbourhood lies a tract of land along the sea-side, which before the year 1666 was inhabited, but is now a desert covered with sand, to the height of twenty feet, i. 221, 222.

Paunch, name of the first stomach of ruminating animals, ii. 4.

Pazan, name of the eighth variety of gazelles, by Mr. Buffon, ii. 145.

Peacock, varieties of this bird—some white, others crested—that of Thibet, the most beautiful of the feathered creation, iii. 95—a saying among the ancients, as beautiful as is the peacock among birds, so is the tiger among quadrupeds, ii. 135—our first were brought from the East-Indies; and they are still found in flocks in a wild state in the islands of Java and Ceylon—the common people of Italy say it has the plumage of an angel, the voice of a devil, and the guts of a thief—in the days of Solomon we find his navies imported from the East apes and peacocks—Ælian relates they were brought into Greece from some barbarous country, and that a male and female were valued at thirty pounds of our money—it is said also, that when Alexander was in India, he saw them flying wild, on the banks of the river Hyarotis, and was so struck with their beauty, that he laid a fine and punishment on all who should kill or disturb them—the Greeks were so much taken with the beauty of this bird, when first brought among them that, it was shewn for money; and many came to Athens from Lacedæmon and Thessali to see it—once esteemed a delicacy at the tables of the rich and great—Anfidus Hurco stands charged by Pliny with being the first who fattened up the peacock for the feasts of the luxurious—Hortensius the orator was the first who served them up at an entertainment at Rome—and they are talked of as the first of viands, iii. 93—in the times of Francis I. it was a custom to serve up peacocks to the tables of the great, not to be eaten, but seen; in what manner they served them—its flesh is said to keep longer unputrefied than any other—has a predilection for barley—but as a proud and fickle bird, there is scarce any food it will at all times like—it strips the tops of houses of tiles or thatch, lays waste to the labours of the gardener, roots up the choicest seeds, and nips favourite flowers in the bud—is still more salacious than the cock—requires five females at least to attend him; and the number not sufficient, will run upon and tread the sitting hen, 94—the peahen, as much as possible hides her nest from him, that he may not disturb her sitting—she seldom lays above five or six eggs in this climate—Aristotle describes her laying twelve—in forests where they breed naturally they are very numerous—this bird lives about twenty years—and not till the third year has that beautiful variegated plumage of its tail—in the kingdom of Cambaya, says Taverner, near the city of Baroch, whole flocks of them are in

the fields—description of their habits—decoy made use of to catch them there, 95.

Sea-peacock, a name given, and by which has been described the Balearic crane, from some resemblance in disposition and manners, iii. 207.

Peak of Teneriff, its volcano seldom free from eruptions, i. 67.

Peak, a noted mountain in the Molucca islands, seen far off at sea, swallowed by an earthquake, and a lake left where it stood i. 104.

Pearl, an animal substance concreted and taking a tincture from the air, iv. 35—found in all bivalved shells, the inside of which resembles that substance called mother of pearl—the formation of pearls a disease or an accident in the animal is not known, 33—common opinion upon this subject—the pearl bred from no disorder in the animal—*pearl-oyster*, from which the mother-of-pearl is taken, 34—several pearl-fisheries—the chief of them in the Persian Gulph, and the most valuable pearls brought from thence—different sizes, figures, and colours—whence their different colours proceed, 35—pearls converted by time and damps into a chalky powder, 36—wretched people destined to fish for pearls—usually die consumptive—in what manner they fish for them, 36. 37.

Pearls in stags, are parts rising from the crust of the beam, ii. 67.

Peasants, the meanest of them in Germany, Poland, and Switzerland, kills a cow for his own table, salts and hangs up, and preserves it as a delicacy all the year round, ii. 7.

Peccary, or *tajacu*, an animal a native of America, at first view resembling a small hog—its description—has upon the back a lump like the navel in other animals—it consists of glands producing a liquor of an offensive smell, ii. 107, 108—when killed the parts of generation and the glands on the back must be taken instantly away, otherwise in half an hour the flesh becomes unfit to be eaten—though like the hog in many respects, is nevertheless a distinct race, and will not mix nor produce an intermediate race—is easily tamed—goes in herds of two or three hundred, and unites, like hogs, in each other's defence—delights not in marshes or mud like our hogs—an unceasing enemy to the lizard, the toad, and the serpent kinds—also feeds upon toads and serpents—any plunderer seizing their young is surounded and often killed, 109, 110.

Pedigree, the Arabians preserve that of their best horses with great care, and for several generations back, i. 442.

Pegu, a river called the Indian Nile, because of the similar overflowings of its stream, i. 136.

Pelagii, the Latin name for those shells fished up from the deep—those cast on the shore are the littorales, iv. 10.

Pelican, a ruminating bird, ii. 5—a native of Africa and America; once known in Europe, particularly in Russia—fabulous accounts propagated of it—the description of it, particularly of its bill, and the great pouch underneath, as wonderful—Tertre affirms the pouch will hide fish enough to serve sixty hungry men for a meal, iii. 240, 241—this pouch placed at the top of the gullet, considered as the crop in other birds—the description of the bird from father Labat, 242—indolent habits in preparing for incubation, and defending their young, 243—their gluttony scarcely to be fished; their flesh rancid, and tastes worse than it smells—use.

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- made by the Americans of their pouches—is not entirely incapable of instruction in a domestic state—instances of it, 244—Aldrovandus mentions one believed to be fifty years old, 245.
- Penguin*, a heavy water fowl; the wings of this tribe unfit for flight, and their legs still more awkwardly adapted for walking, our sailors call them arse feet—they dive to the bottom, or swim between two waters, 261, 262—they never visit land but when coming to breed—their colour—are covered more warmly with feathers than other birds—description of the Magellanic penguin, they unite in them the qualities of men, fowls, and fishes, 263—instances of its gluttonous appetite—their food and flesh—are a bird of society—season of laying, and manner of making their nests—some of this tribe called by our seamen the booby—our men first coming among them, were not distrusted nor avoided, they stood to be shot at in flocks, till every one was destroyed—the females let them take their eggs without any resistance—the penguin lays but one egg; in frequented shores—burrows like a rabbit—three or four take possession of one hole, and hatch—one is placed as a sentinel to warn of approaching danger, 264, 265—union between this bird and the albatross, and regularity in their building together, 257.
- Peninsula of India*, on one side the coasts are near half the year harassed by violent hurricanes and northern tempests, i. 348—the people there employ the elephant chiefly in carrying or drawing burthens, ii. 314, 315.
- Penpark-hole*, in Gloucestershire, twenty-five fathoms perpendicular depth—its description from captain Sturme, i. 48.
- People*, so young as fourteen or fifteen often found to cease growing, i. 287.
- Pepper*, the Indians prefer that devoured and voided unconcocted by the toucan, before the pepper fresh gathered from the tree, iii. 130.
- Perch*, a prickly-finned thoracic fish—its description, iii. 377.
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- Peruvians*, father Acosta and Garcilasso de la Vega, make no doubt but that they understood the art of preserving their dead for a long space of time, i. 398.
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- Phatagin*, an animal less than the pangolin—the extent of its tail above twice the length of its body—countries where it is to be found, ii. 305.
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- Shells of the sea*, scarce one met with entire and sound to the end of its convolutions, and why, iv. 23—of all sea-shells, that of the nautilus, the thinnest and most easily pierced, ib.—all bivalved shells furnish pearls, and their insides resemble and afford that substance called mother-of-pearl, 33, 34—some pierced by worms argue them food for such animals, 12.
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- Shetland isles*, amazing quantity of herrings appearing off these islands, iii. 390.
- Shores*, of all those in the world, not one so high as that to the west of St. Kilda, six hundred fathom perpendicular above the surface of the sea, i. 168—some on which the sea has made temporary depredations, 172.
- Short heads*, name given by sailors to the young of the whale, whilst at the breast, iii. 320.
- Shoveller*, species of the crane kind—its food—inhabitants of the Cape of Good Hope respect it as the ancient Egyptians did their bird ibis—its nest and eggs, iii. 218.
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